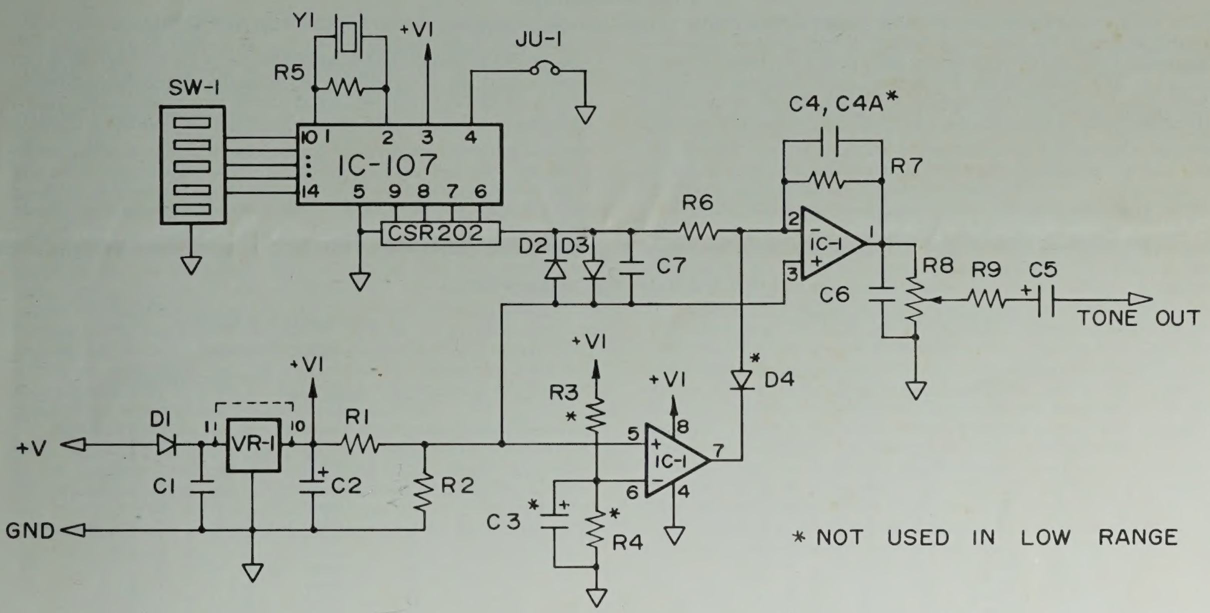
SS-32 INSTRUCTION SHEET

Communications Specialists
426 W. Taft Ave., Orange, CA 92667
(714) 998-3021 (California) / (800) 854-0547

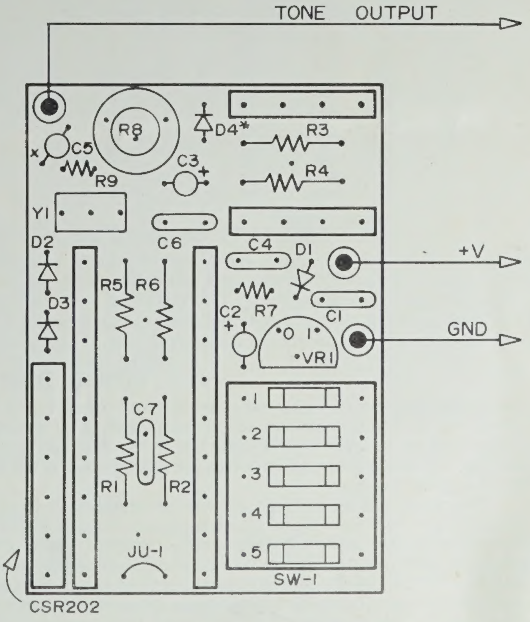


* NOT USED IN LOW RANGE

SS-32 ENCODER PARTS LIST

R1 -	10K 1/8 watt 5% resistor, carbon film	$.31 ea.
R2 -	9.1K " " " " "	.31 ea.
*R3 -	470K " " " " "	.31 ea.
*R4 -	1Meg " " " " "	.31 ea.
R5 -	10Meg " " " " comp.	.31 ea.
R6 -	15K " " " " film	.31 ea.
R7 -	120K " " " " "	.31 ea.
R8 -	5K Mepco pot	1.39 ea.
R9 -	1.2K 1/8 watt 5% resistor, carbon film	.31 ea.
C1 -	.033uf 50v CW15 capacitor, mono.	1.75 ea.
C2 -	1uf 35v tantalum capacitor	1.05 ea.
*C3 -	1uf " " "	1.05 ea.
C4 -	.01uf 50v CW15 capacitor, mono.	1.50 ea.
*C4A -	470pf " " " "	1.00 ea.
C5 -	1uf 35v tantalum capacitor	1.05 ea.
C6 -	100pf 50v CW15 capacitor, mono.	1.00 ea.
C7 -	100pf " " " "	1.00 ea.
D1 -	1N4148 silicon diode	.15 ea.
D2 -	1N4148 " "	.15 ea.
D3 -	1N4148 " "	.15 ea.
*D4 -	1N4148 " "	.15 ea.
Y1 -	1Mhz crystal	7.50 ea.
VR-1 -	78L08A regulator	1.00 ea.
CSR202-	Resistor network	2.30 ea.
SW-1 -	5 position DIP switch	2.45 ea.
IC-107 -	Com-Spec microcircuit	17.50 ea.
IC-1 -	TL062 microcircuit	2.20 ea.
2 -	9 pin socket strips	.39 ea.
2 -	4 pin socket strips	.35 ea.
3 -	AMP chassis pins	.10 ea.
1 -	Printed circuit board	5.00 ea.
JU-1 -	Jumper wire	.01 ea.
	33 pos. binary switch (for remote operation)	9.95 ea.

**These items not used on sub-audible board.*



* REMOVE FOR CONTINUOUS TONE

MOUNTING

Mount the unit with the mounting items supplied. Do not mount the unit with silicon seal or any other type glues as this will void warranty. When making connections to the board be sure to use the plug on wires supplied. Do not solder the wires to the circuit board terminals.

PROGRAMMING

This programmable line of products uses a five position DIP switch to select the frequency desired. When the switches are in any particular position, this binary code tells the integrated circuit which of the coded tones the system is to operate on. For instance, if 1Z (100.0Hz.) is desired, the code rquired is located on the instruction sheet and the switches are programmed accordingly. For example, the code for a 1Z is "11010", thus switch #1 is turned OFF (corresponding to a "1"), switch #2 is turned OFF, switch #3 is turned ON (corresponding to a "0"), switch #4 is OFF, and switch #5 is turned ON. By selecting the variable combinations of switch positions, all 32 tones can be accessed. Special tones are available also by using a different frequency crystal.

DIP SWITCH PROGRAMMING

FOR CTCSS PRODUCTS GROUP A

			SWITCH NUMBER*				
#	FREQ.	CODE	5	4	3	2	1
1	67.0	XZ	0	0	0	0	0
2	71.9	XA	0	0	0	0	1
3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
6	82.5	YZ	0	0	1	0	1
7	85.4	YA	0	0	1	1	0
8	88.5	YB	0	0	1	1	1
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10	94.8	ZA	0	1	0	0	1
11	97.4	ZB	0	1	0	1	0
12	100.0	1Z	0	1	0	1	1
13	103.5	1A	0	1	1	0	0
14	107.2	1B	0	1	1	0	1
15	110.9	2Z	0	1	1	1	0
16	114.8	2A	0	1	1	1	1
17	118.8	2B	1	0	0	0	0
18	123.0	3Z	1	0	0	0	1
19	127.3	3A	1	0	0	1	0
20	131.8	3B	1	0	0	1	1
21	136.5	4Z	1	0	1	0	0
22	141.3	4A	1	0	1	0	1
23	146.2	4B	1	0	1	1	0
24	151.4	5Z	1	0	1	1	1
25	156.7	5A	1	1	0	0	0
26	162.2	5B	1	1	0	0	1
27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

FOR GROUP B TONES *REMOVE JU-1*

		SWITCH NUMBERS*				
#	FREQ. (Hz)	5	4	3	2	1
1	600.0	0	0	0	0	0
2	1000.0	0	0	0	0	1
3	1500.0	0	0	0	1	0
4	1600.0	0	0	0	1	1
5	1650.0	0	0	1	0	0
6	1700.0	0	0	1	0	1
7	1750.0	0	0	1	1	0
8	697.0	0	0	1	1	1
9	1800.0	0	1	0	0	0
10	1850.0	0	1	0	0	1
11	1900.0	0	1	0	1	0
12	770.0	0	1	0	1	1
13	1950.0	0	1	1	0	0
14	852.0	0	1	1	0	1
15	941.0	0	1	1	1	0
16	2000.0	0	1	1	1	1
17	2100.0	1	0	0	0	0
18	2150.0	1	0	0	0	1
19	2200.0	1	0	0	1	0
20	2250.0	1	0	0	1	1
21	2300.0	1	0	1	0	0
22	2350.0	1	0	1	0	1
23	2400.0	1	0	1	1	0
24	1209.0	1	0	1	1	1
25	2450.0	1	1	0	0	0
26	2500.0	1	1	0	0	1
27	2550.0	1	1	0	1	0
28	1336.0	1	1	0	1	1
29	2175.0	1	1	1	0	0
30	1477.0	1	1	1	0	1
31	1633.0	1	1	1	1	0
32	2805.0	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

POWER AND GROUND CONNECTIONS

The ground connection is typically very straight forward. The main ground foil on the printed circuit foil works well, or a connection to the chassis. Be careful of a radio which has multiple grounds, such as a chassis ground and a true vehicle ground. A GE Mastr Pro is a good example.

The power connection can be any unregulated positive D.C. voltage from +6.0 to +30.0V. Use a regulated voltage if it is convenient. However, with voltages below 9.0VDC, place a wire jumper across the regulator (VR-1) on the circuit board. See the circuit board pictorial for the placement of the jumper. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 30VDC. To determine the value of the resistor (in Kohms) use the following formula: R = (V - 22) / 8. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

Mobiles, 12V negative ground—standard hook-up (see above).
Mobiles, 12V positive ground—reverse board +V and GND connections.
Mobiles, 6V pos. or neg. ground— use B+ dropping method.
Bases—use appropriate figure 1, 2, 3.
Portables, 9V or less—by-pass regulator, VR-1.

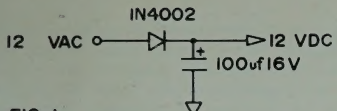


FIG. 1

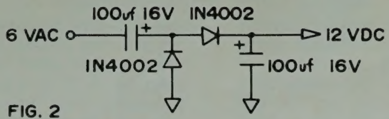


FIG. 2

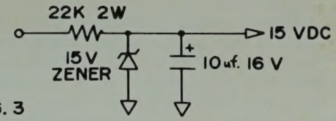


FIG. 3

PROCEDURE FOR CONNECTING SUB-AUDIBLE ENCODER TONE TO TRANSMITTER

The encoder tone output is typically connected just prior to the modulator stage. Typical connections would be to the center of the deviation control, to the input of the final audio driver, to the varactor modulator diodes or to the manufacturer's normal connection point. This connection point varies with each different model radio, and you must determine which provides the best results. In a tube type transmitter, the grid of the modulator is often used, or a varactor kit should be used to modulate the crystal directly in a tube type or solid state transmitter, see figure E1. The VARACTOR (transistor base to collector junction of an NPN silicon transistor) changes A.C. voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method. Various values of coupling capacitors are shown for different frequency ranges of the transmitter. A higher value of capacitance will increase the deviation level, however if the capacitance is too high, it may be difficult to set the transmitter on frequency. Varactor Kits are available from us for $3.00 each. Use this method if other connection points prove unsuccessful.

DO NOT connect the encoder tone to the microphone input as this invariably causes excessive tone and harmonic distortion due to the frequency response of the transmitter's speech amplifier. The speech amplifier has a typical response of 300Hz to 3000Hz and does not permit the fundamental tone to be transmitted. This is the usual cause of a distorted tone output as monitored on a deviation scope.

The output of our encoder is low Z, so it is capable of driving low Z loads. Insufficient level output should never be a problem. However, if you are driving a high Z load such as 100k deviation pot, then a series isolation resistor should be used so the encoder will not load down the normal voice modulation. This resistor value must be determined experimentally, but a 100k resistor would be a good starting point. This value could change from 10K to 1 meg depending on the radio used.

If tone distortion continues to be a problem, then a capacitor can be placed on the tone output to provide additional filtering where required, see figure E2. This is most noticeable in phase modulators since the frequency response seems to be quite poor at the low end of the audio range. If you are using a deviation scope, then little spikes will be riding on the sine wave output, and this will sound like a buzz. The additional filtering will cure the problem. True FM modulators do not have this problem and are very easy to work with and interface very well with sub-audible encoders. These modulators can be identified quite easily since the audio is fed into a varactor which is often connected in parallel with the crystal. If the purity of the encoder output is in question, look at the output of the encoder with an oscilloscope.

Most UHF transmitters interface quite well with sub-audible encoders. This is primarily due to the high multiplication factor from the modulator to the final amplifier stage. Because of the lower number of multiplication stages in low band transmitters, sufficient deviation level can sometimes be difficult to obtain.

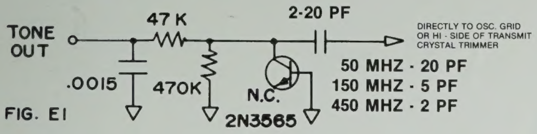


FIG. E1

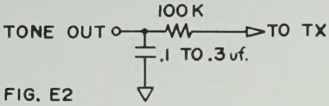


FIG. E2

PROCEDURE FOR CONNECTING AUDIBLE ENCODER TONE TO TRANSMITTER

Audible tone can be connected directly to the microphone input. When driving a high impedance load, a series isolation resistor will be required so the voice modulation will not be affected. If insufficient level seems to be a problem, then inject the tone at the input of the next amplifier stage in the transmitter. Be sure to use a series resistor if modulation level is reduced. If continuous tone is required when encoding from Group B, then remove diode D4, as shown on the CIRCUIT BOARD PICTORIAL. The length of the tone burst may be changed if necessary by adjusting the value of R3. If a longer burst is desired, then increase the value of R3 100K ohms for every 100ms. increase in tone length. The opposite holds true for reduced length.

RF INTERFERENCE

Although our encoders are not susceptable to RF, care must be taken when locating the unit, and how the wires are routed. In most cases of RF interference it has been found that the RF is coupled into the leads of the encoder and then fed back into the radio itself where the RF upsets the bias conditions in the transmitter. This causes distortion and other unusual effects. But under these conditions it will be noted that the encoder is still working properly. This is most common in portable hand held radios, since often the circuitry is compromised slightly to achieve the small size required. Often a small by-pass capacitor such as a 100pf. on the radio's circuit board works quite well. Also, keeping all leads as short as possible or re-routing the wires helps.

MULTI-TONE APPLICATIONS

By adding a little additional circuitry, our programmable line of products may be frequency programmed by remote means. Since these products all use DC signals for switching, any number of tones may be switched in or out without being concerned with additional lead length, or stray capacitance affecting the frequency. This is a typical problem associated with tunable or reed type units.

There are a number of ways of changing frequencies from a remote location. The easiest way is to use a 33 position binary switch (available from us) which connects in parallel with the 5 position DIP switch on the circuit board. Thus all 32 tones may be accessed by rotating through all positions on the switch, with the first position on the switch being the off condition (see figure M1). When connections are made in this manner, position ONE will be the off condition, and the path from "G" to "H" will be open thereby removing power from the programmable board. Position TWO would be 67.0Hz (Group A), position three would be 71.9Hz, and so on up to position 33 which would be 203.5Hz. When using the binary switch be sure all five positions on the DIP switch are in the **OFF** condition.

The other method for adding additional frequencies is to use a single pole rotary switch with as many positions as the number of different frequencies required. Using this method, a diode for line isolation must be used in each leg of the program code which requires a "0" or a ground for programming (see figure M2). In this example, three frequencies are required to operate a three site repeater system. The sub-audible tones required to access all three sites are 5Z (151.4Hz), 4B (146.2Hz), and YZ (82.5Hz). The frequency code is located on the programming chart for each of the three frequencies and these codes are converted to the appropriate diode array for each frequency. For example, position number two on the rotary switch must be 146.2Hz. This corresponds to "10110" on the program chart. By looking at this code, it is determined that 2 diodes will be required on the locations containing a "0", and no connection is required in the locations containing a "1". Thus the lines from pin 11, and pin 14, on IC-107 are pulled to ground through the series diodes when the rotary switch is in position number two. This method works quite well where space is a factor, and is best when only a few frequencies are required. Be sure all five positions on the DIP switch are in the **OFF** condition when changing frequencies remotely.

FIGURE – M1

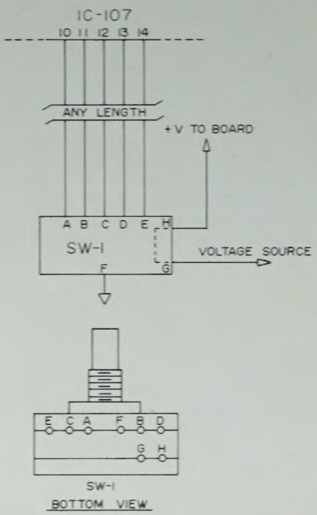
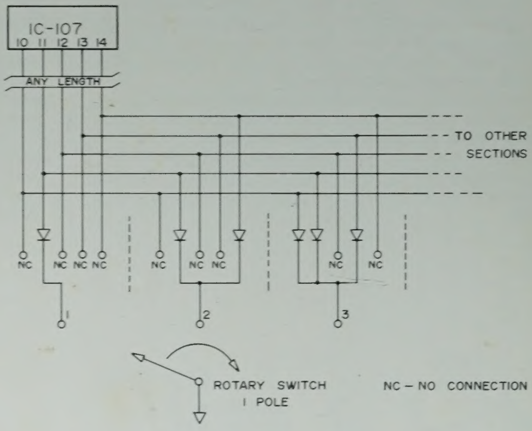


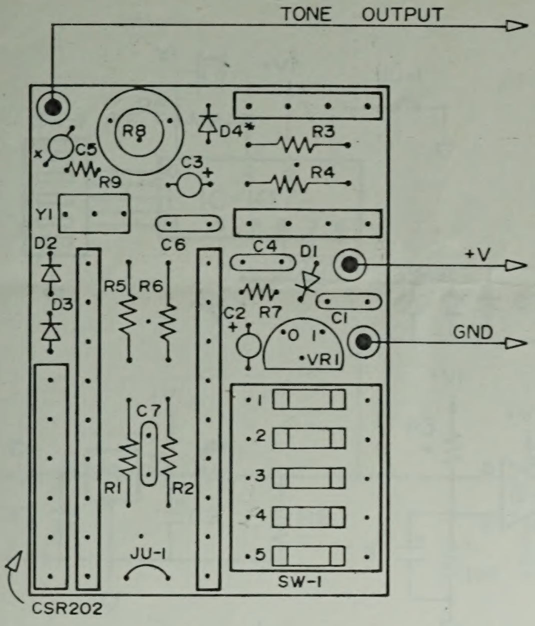
FIGURE – M2



SS-32 to Yaesu FT-227R

14971

Santee



(MOD) on PB-1659 Main unit

+13.8VDC on PB-1659 Main unit

(PTT) on PB-1659 Main unit

* REMOVE FOR CONTINUOUS TONE

NOTE:

The power for the SS-32 is taken across the coil of relay RL101 on PB-1659 on main unit...

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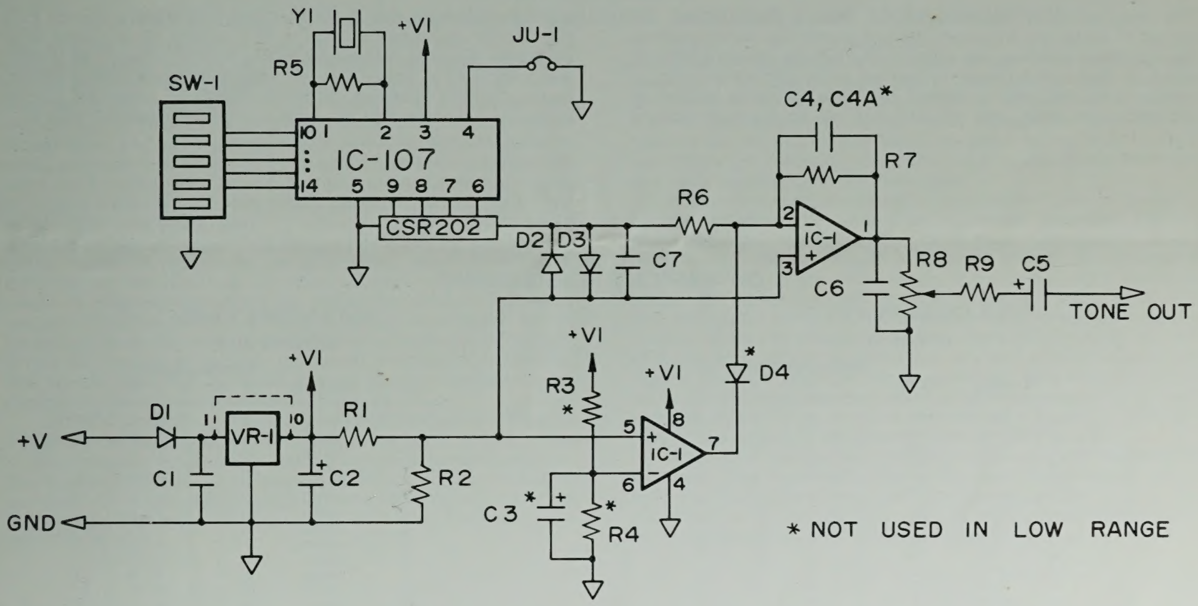

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SS-32 ENCODER PARTS LIST

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R2 -	9.1K	"	"	"	"	"	.31 ea.
*R3 -	470K	"	"	"	"	"	.31 ea.
*R4 -	1Meg	"	"	"	"	"	.31 ea.
R5 -	10Meg	"	"	"	"	comp.	.31 ea.
R6 -	15K	"	"	"	"	film	.31 ea.
R7 -	120K	"	"	"	"	"	.31 ea.
R8 -	5K	Mepco	pot				1.39 ea.
R9 -	1.2K	1/8 watt	5%	resistor,	carbon	film	.31 ea.
C1 -	.033uf	50v	CW15	capacitor,	mono.		1.75 ea.
C2 -	1uf	35v	tantalum	capacitor			1.05 ea.
*C3 -	1uf	"	"	"			1.05 ea.
C4 -	.01uf	50v	CW15	capacitor,	mono.		1.50 ea.
*C4A -	470pf	"	"	"	"		1.00 ea.
C5 -	1uf	35v	tantalum	capacitor			1.05 ea.
C6 -	100pf	50v	CW15	capacitor,	mono.		1.00 ea.
C7 -	100pf	"	"	"	"		1.00 ea.
D1 -	1N4148	silicon	diode				.15 ea.
D2 -	1N4148	"	"				.15 ea.
D3 -	1N4148	"	"				.15 ea.
*D4 -	1N4148	"	"				.15 ea.
Y1 -	1Mhz	crystal					7.50 ea.
VR-1 -	78L08A regulator						1.00 ea.
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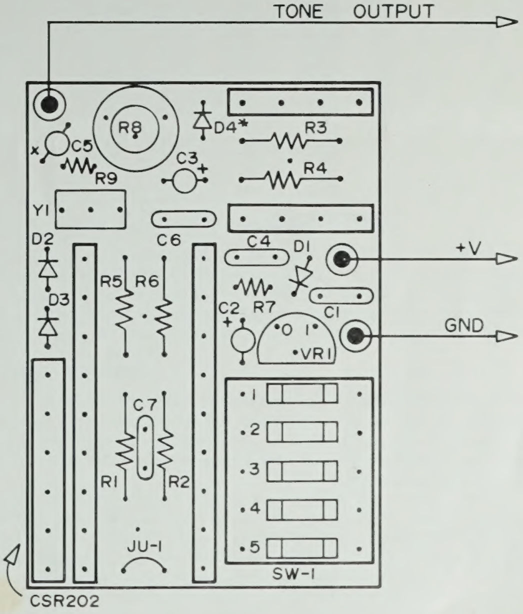

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DIP SWITCH PROGRAMMING

FOR CTCSS PRODUCTS
GROUP A

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3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
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27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

FOR GROUP B TONES
REMOVE JU-1

#	FREQ. (Hz)	SWITCH NUMBERS* 5	4	3	2	1
1	600.0	0	0	0	0	0
2	1000.0	0	0	0	0	1
3	1500.0	0	0	0	1	0
4	1600.0	0	0	0	1	1
5	1650.0	0	0	1	0	0
6	1700.0	0	0	1	0	1
7	1750.0	0	0	1	1	0
8	697.0	0	0	1	1	1
9	1800.0	0	1	0	0	0
10	1850.0	0	1	0	0	1
11	1900.0	0	1	0	1	0
12	770.0	0	1	0	1	1
13	1950.0	0	1	1	0	0
14	852.0	0	1	1	0	1
15	941.0	0	1	1	1	0
16	2000.0	0	1	1	1	1
17	2100.0	1	0	0	0	0
18	2150.0	1	0	0	0	1
19	2200.0	1	0	0	1	0
20	2250.0	1	0	0	1	1
21	2300.0	1	0	1	0	0
22	2350.0	1	0	1	0	1
23	2400.0	1	0	1	1	0
24	1209.0	1	0	1	1	1
25	2450.0	1	1	0	0	0
26	2500.0	1	1	0	0	1
27	2550.0	1	1	0	1	0
28	1336.0	1	1	0	1	1
29	2175.0	1	1	1	0	0
30	1477.0	1	1	1	0	1
31	1633.0	1	1	1	1	0
32	2805.0	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

POWER AND GROUND CONNECTIONS

The ground connection is typically very straight forward. The main ground foil on the printed circuit foil works well, or a connection to the chassis. Be careful of a radio which has multiple grounds, such as a chassis ground and a true vehicle ground. A GE Mastr Pro is a good example.

The power connection can be any unregulated positive D.C. voltage from +6.0 to +30.0V. Use a regulated voltage if it is convenient. However, with voltages below 9.0VDC, place a wire jumper across the regulator (VR-1) on the circuit board. See the circuit board pictorial for the placement of the jumper. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 30VDC. To determine the value of the resistor (in Kohms) use the following formula: $R = (V - 22) / 8$. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

Mobiles, 12V negative ground—standard hook-up (see above).
Mobiles, 12V positive ground—reverse board +V and GND connections.
Mobiles, 6V pos. or neg. ground— use B+ dropping method.
Bases—use appropriate figure 1, 2, 3.
Portables, 9V or less—by-pass regulator, VR-1.

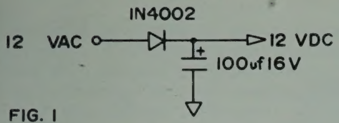


FIG. I

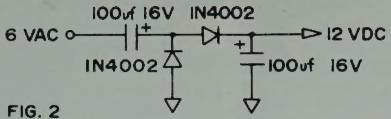


FIG. 2

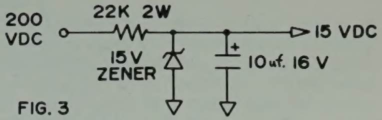


FIG. 3

PROCEDURE FOR CONNECTING SUB-AUDIBLE ENCODER TONE TO TRANSMITTER

The encoder tone output is typically connected just prior to the modulator stage. Typical connections would be to the center of the deviation control, to the input of the final audio driver, to the varactor modulator diodes or to the manufacturer's normal connection point. This connection point varies with each different model radio, and you must determine which provides the best results. In a tube type transmitter, the grid of the modulator is often used, or a varactor kit should be used to modulate the crystal directly in a tube type or solid state transmitter, see figure E1. The VARACTOR (transistor base to collector junction of an NPN silicon transistor) changes A.C. voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method. Various values of coupling capacitors are shown for different frequency ranges of the transmitter. A higher value of capacitance will increase the deviation level, however if the capacitance is too high, it may be difficult to set the transmitter on frequency. Varactor Kits are available from us for $3.00 each. Use this method if other connection points prove unsuccessful.

DO NOT connect the encoder tone to the microphone input as this invariably causes excessive tone and harmonic distortion due to the frequency response of the transmitter's speech amplifier. The speech amplifier has a typical response of 300Hz to 3000Hz and does not permit the fundamental tone to be transmitted. This is the usual cause of a distorted tone output as monitored on a deviation scope.

The output of our encoder is low Z, so it is capable of driving low Z loads. Insufficient level output should never be a problem. However, if you are driving a high Z load such as 100k deviation pot, then a series isolation resistor should be used so the encoder will not load down the normal voice modulation. This resistor value must be determined experimentally, but a 100k resistor would be a good starting point. This value could change from 10K to 1 meg depending on the radio used.

If tone distortion continues to be a problem, then a capacitor can be placed on the tone output to provide additional filtering where required, see figure E2. This is most noticeable in phase modulators since the frequency response seems to be quite poor at the low end of the audio range. If you are using a deviation scope, then little spikes will be riding on the sine wave output, and this will sound like a buzz. The additional filtering will cure the problem. True FM modulators do not have this problem and are very easy to work with and interface very well with sub-audible encoders. These modulators can be identified quite easily since the audio is fed into a varactor which is often connected in parallel with the crystal. If the purity of the encoder output is in question, look at the output of the encoder with an oscilloscope.

Most UHF transmitters interface quite well with sub-audible encoders. This is primarily due to the high multiplication factor from the modulator to the final amplifier stage. Because of the lower number of multiplication stages in low band transmitters, sufficient deviation level can sometimes be difficult to obtain.

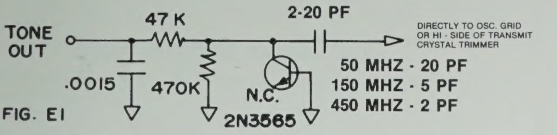


FIG. EI

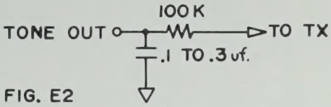


FIG. E2

PROCEDURE FOR CONNECTING AUDIBLE ENCODER TONE TO TRANSMITTER

Audible tone can be connected directly to the microphone input. When driving a high impedance load, a series isolation resistor will be required so the voice modulation will not be affected. If insufficient level seems to be a problem, then inject the tone at the input of the next amplifier stage in the transmitter. Be sure to use a series resistor if modulation level is reduced. If continuous tone is required when encoding from Group B, then remove diode D4, as shown on the CIRCUIT BOARD PICTORIAL. The length of the tone burst may be changed if necessary by adjusting the value of R3. If a longer burst is desired, then increase the value of R3 100K ohms for every 100ms. increase in tone length. The opposite holds true for reduced length.

RF INTERFERENCE

Although our encoders are not susceptable to RF, care must be taken when locating the unit, and how the wires are routed. In most cases of RF interference it has been found that the RF is coupled into the leads of the encoder and then fed back into the radio itself where the RF upsets the bias conditions in the transmitter. This causes distortion and other unusual effects. But under these conditions it will be noted that the encoder is still working properly. This is most common in portable hand held radios, since often the circuitry is compromised slightly to achieve the small size required. Often a small by-pass capacitor such as a 100pf. on the radio's circuit board works quite well. Also, keeping all leads as short as possible or re-routing the wires helps.

MULTI-TONE APPLICATIONS

By adding a little additional circuitry, our programmable line of products may be frequency programmed by remote means. Since these products all use DC signals for switching, any number of tones may be switched in or out without being concerned with additional lead length, or stray capacitance affecting the frequency. This is a typical problem associated with tunable or reed type units.

There are a number of ways of changing frequencies from a remote location. The easiest way is to use a 33 position binary switch (available from us) which connects in parallel with the 5 position DIP switch on the circuit board. Thus all 32 tones may be accessed by rotating through all positions on the switch, with the first position on the switch being the off condition (see figure M1). When connections are made in this manner, position ONE will be the off condition, and the path from "G" to "H" will be open thereby removing power from the programmable board. Position TWO would be 67.0Hz (Group A), position three would be 71.9Hz, and so on up to position 33 which would be 203.5Hz. When using the binary switch be sure all five positions on the DIP switch are in the **OFF** condition.

The other method for adding additional frequencies is to use a single pole rotary switch with as many positions as the number of different frequencies required. Using this method, a diode for line isolation must be used in each leg of the program code which requires a "0" or a ground for programming (see figure M2). In this example, three frequencies are required to operate a three site repeater system. The sub-audible tones required to access all three sites are 5Z (151.4Hz), 4B (146.2Hz), and YZ (82.5Hz). The frequency code is located on the programming chart for each of the three frequencies and these codes are converted to the appropriate diode array for each frequency. For example, position number two on the rotary switch must be 146.2Hz. This corresponds to "10110" on the program chart. By looking at this code, it is determined that 2 diodes will be required on the locations containing a "0", and no connection is required in the locations containing a "1". Thus the lines from pin 11, and pin 14, on IC-107 are pulled to ground through the series diodes when the rotary switch is in position number two. This method works quite well where space is a factor, and is best when only a few frequencies are required. Be sure all five positions on the DIP switch are in the **OFF** condition when changing frequencies remotely.

FIGURE – M1

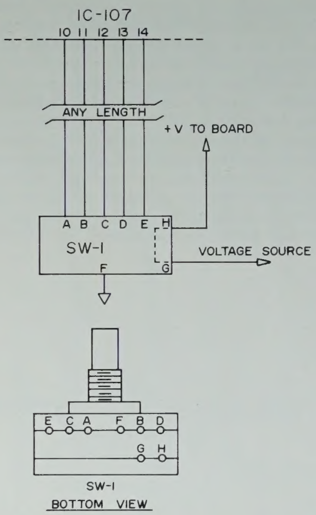
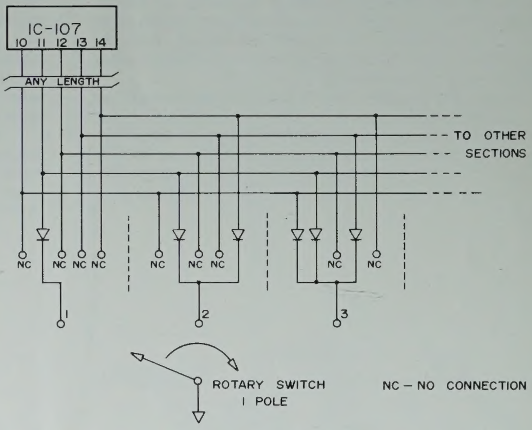
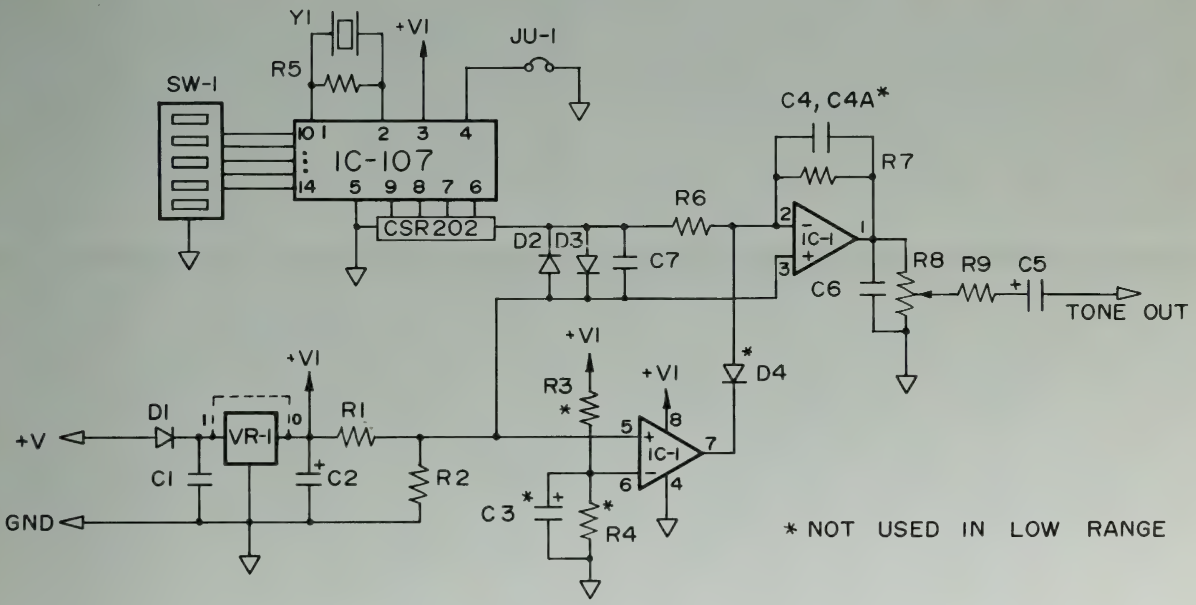


FIGURE – M2



SS-32 INSTRUCTION SHEET

Communications Specialists
426 W. Taft Ave., Orange, CA 92667
(714) 998-3021 (California) / (800) 854-0547

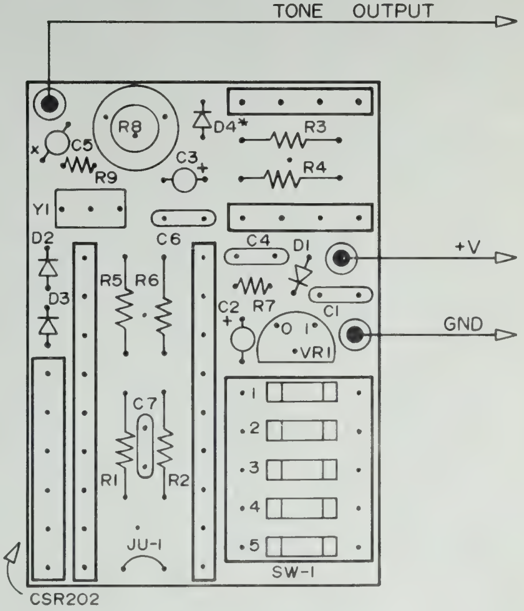


* NOT USED IN LOW RANGE

SS-32 ENCODER PARTS LIST

Part	Value	Description	Price
R1 -	10K	1/8 watt 5% resistor, carbon film	$.31 ea.
R2 -	9.1K	" " " " "	.31 ea.
*R3 -	470K	" " " " "	.31 ea.
*R4 -	1Meg	" " " " "	.31 ea.
R5 -	10Meg	" " " " comp.	.31 ea.
R6 -	15K	" " " " film	.31 ea.
R7 -	120K	" " " " "	.31 ea.
R8 -	5K	Mepco pot	1.39 ea.
R9 -	1.2K	1/8 watt 5% resistor, carbon film	.31 ea.
C1 -	.033uf	50v CW15 capacitor, mono.	1.75 ea.
C2 -	1uf	35v tantalum capacitor	1.05 ea.
*C3 -	1uf	" " "	1.05 ea.
C4 -	.01uf	50v CW15 capacitor, mono.	1.50 ea.
*C4A -	470pf	" " " "	1.00 ea.
C5 -	1uf	35v tantalum capacitor	1.05 ea.
C6 -	100pf	50v CW15 capacitor, mono.	1.00 ea.
C7 -	100pf	" " " "	1.00 ea.
D1 -	1N4148	silicon diode	.15 ea.
D2 -	1N4148	" "	.15 ea.
D3 -	1N4148	" "	.15 ea.
*D4 -	1N4148	" "	.15 ea.
Y1 -	1Mhz	crystal	7.50 ea.
VR-1 -	78L08A	regulator	1.00 ea.
CSR202-		Resistor network	2.30 ea.
SW-1 -		5 position DIP switch	2.45 ea.
IC-107 -		Com-Spec microcircuit	17.50 ea.
IC-1 -		TL062 microcircuit	2.20 ea.
2 -		9 pin socket strips	.39 ea.
2 -		4 pin socket strips	.35 ea.
3 -		AMP chassis pins	.10 ea.
1 -		Printed circuit board	5.00 ea.
JU-1 -		Jumper wire	.01 ea.
		33 pos. binary switch (for remote operation)	9.95 ea.

**These items not used on sub-audible board.*



* REMOVE FOR CONTINUOUS TONE

MOUNTING

Mount the unit with the mounting items supplied. Do not mount the unit with silicon seal or any other type glues as this will void warranty. When making connections to the board be sure to use the plug on wires supplied. Do not solder the wires to the circuit board terminals.

PROGRAMMING

This programmable line of products uses a five position DIP switch to select the frequency desired. When the switches are in any particular position, this binary code tells the integrated circuit which of the coded tones the system is to operate on. For instance, if 1Z (100.0Hz.) is desired, the code rquired is located on the instruction sheet and the switches are programmed accordingly. For example, the code for a 1Z is "11010", thus switch #1 is turned OFF (corresponding to a "1"), switch #2 is turned OFF, switch #3 is turned ON (corresponding to a "0"), switch #4 is OFF, and switch #5 is turned ON. By selecting the variable combinations of switch positions, all 32 tones can be accessed. Special tones are available also by using a different frequency crystal.

DIP SWITCH PROGRAMMING

FOR CTCSS PRODUCTS
GROUP A

			SWITCH NUMBER*				
#	FREQ.	CODE	5	4	3	2	1
1	67.0	XZ	0	0	0	0	0
2	71.9	XA	0	0	0	0	1
3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
6	82.5	YZ	0	0	1	0	1
7	85.4	YA	0	0	1	1	0
8	88.5	YB	0	0	1	1	1
9	91.5	ZZ	0	1	0	0	0
10	94.8	ZA	0	1	0	0	1
11	97.4	ZB	0	1	0	1	0
12	100.0	1Z	0	1	0	1	1
13	103.5	1A	0	1	1	0	0
14	107.2	1B	0	1	1	0	1
15	110.9	2Z	0	1	1	1	0
16	114.8	2A	0	1	1	1	1
17	118.8	2B	1	0	0	0	0
18	123.0	3Z	1	0	0	0	1
19	127.3	3A	1	0	0	1	0
20	131.8	3B	1	0	0	1	1
21	136.5	4Z	1	0	1	0	0
22	141.3	4A	1	0	1	0	1
23	146.2	4B	1	0	1	1	0
24	151.4	5Z	1	0	1	1	1
25	156.7	5A	1	1	0	0	0
26	162.2	5B	1	1	0	0	1
27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

FOR GROUP B TONES
REMOVE JU-1

		SWITCH NUMBERS*				
#	FREQ. (Hz)	5	4	3	2	1
1	600.0	0	0	0	0	0
2	1000.0	0	0	0	0	1
3	1500.0	0	0	0	1	0
4	1600.0	0	0	0	1	1
5	1650.0	0	0	1	0	0
6	1700.0	0	0	1	0	1
7	1750.0	0	0	1	1	0
8	697.0	0	0	1	1	1
9	1800.0	0	1	0	0	0
10	1850.0	0	1	0	0	1
11	1900.0	0	1	0	1	0
12	770.0	0	1	0	1	1
13	1950.0	0	1	1	0	0
14	852.0	0	1	1	0	1
15	941.0	0	1	1	1	0
16	2000.0	0	1	1	1	1
17	2100.0	1	0	0	0	0
18	2150.0	1	0	0	0	1
19	2200.0	1	0	0	1	0
20	2250.0	1	0	0	1	1
21	2300.0	1	0	1	0	0
22	2350.0	1	0	1	0	1
23	2400.0	1	0	1	1	0
24	1209.0	1	0	1	1	1
25	2450.0	1	1	0	0	0
26	2500.0	1	1	0	0	1
27	2550.0	1	1	0	1	0
28	1336.0	1	1	0	1	1
29	2175.0	1	1	1	0	0
30	1477.0	1	1	1	0	1
31	1633.0	1	1	1	1	0
32	2805.0	1	1	1	1	1

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POWER AND GROUND CONNECTIONS

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The power connection can be any unregulated positive D.C. voltage from +6.0 to +30.0V. Use a regulated voltage if it is convenient. However, with voltages below 9.0VDC, place a wire jumper across the regulator (VR-1) on the circuit board. See the circuit board pictorial for the placement of the jumper. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 30VDC. To determine the value of the resistor (in Kohms) use the following formula: R = (V - 22) / 8. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

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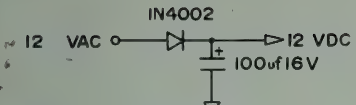

FIG. 1

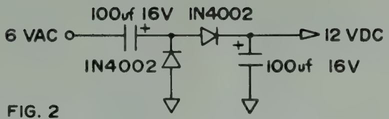

FIG. 2

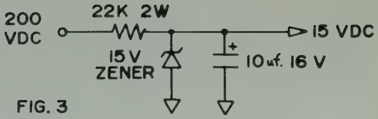

FIG. 3

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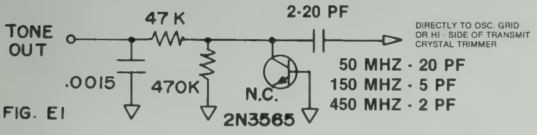

FIG. E1

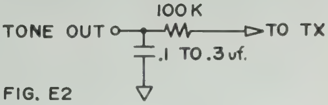

FIG. E2

PROCEDURE FOR CONNECTING AUDIBLE ENCODER TONE TO TRANSMITTER

Audible tone can be connected directly to the microphone input. When driving a high impedance load, a series isolation resistor will be required so the voice modulation will not be affected. If insufficient level seems to be a problem, then inject the tone at the input of the next amplifier stage in the transmitter. Be sure to use a series resistor if modulation level is reduced. If continuous tone is required when encoding from Group B, then remove diode D4, as shown on the CIRCUIT BOARD PICTORIAL. The length of the tone burst may be changed if necessary by adjusting the value of R3. If a longer burst is desired, then increase the value of R3 100K ohms for every 100ms. increase in tone length. The opposite holds true for reduced length.

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FIGURE – M1

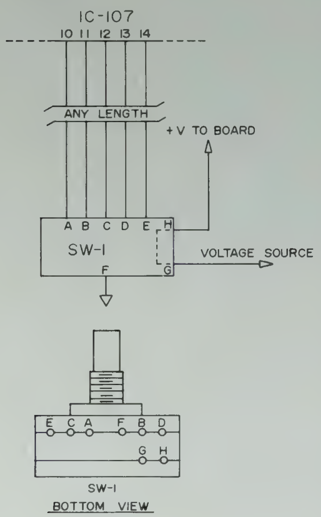
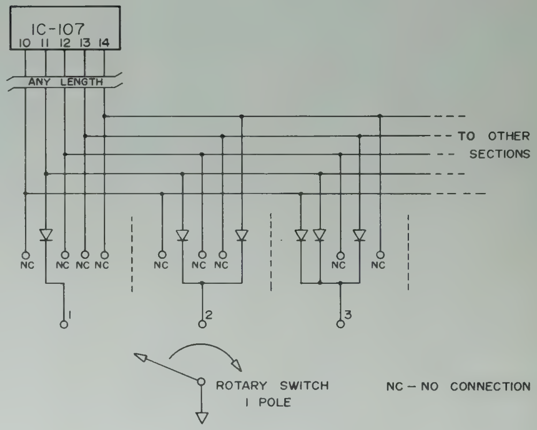


FIGURE – M2



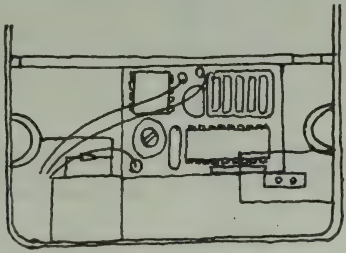
Tech. Bulletin #810215

SANTEC
HT-1200

SS-32 SUBTONE INSTALLATION

1. Remove back and battery. Remove the two screws holding the front.

2. Install the SS-32 in the space provided. Utilize the orientation shown to prevent interference to the lock mechanism. If tape is used to hold the module it must not be foam but the thin doublesided tape.



3. Put two ferrite beads on the positive power line to the SS-32 and route thru the opening in the chassis and connect to point "F" (Terminal usually has a brown wire. Make sure it is the Tx-PS circuit you have chosen).

4. Put two ferrite beads on the ground wire of the power supply line. Connect to the can of T-9 or T-10.

5. Use a small diameter COAX to connect the audio line to point "A". Put a ferrite bead on the center of the COAX at both ends. At the SS-32 end put a 50k-100k resistor in series with the audio line and a .22 dip tantalum to ground from the audio out pin.

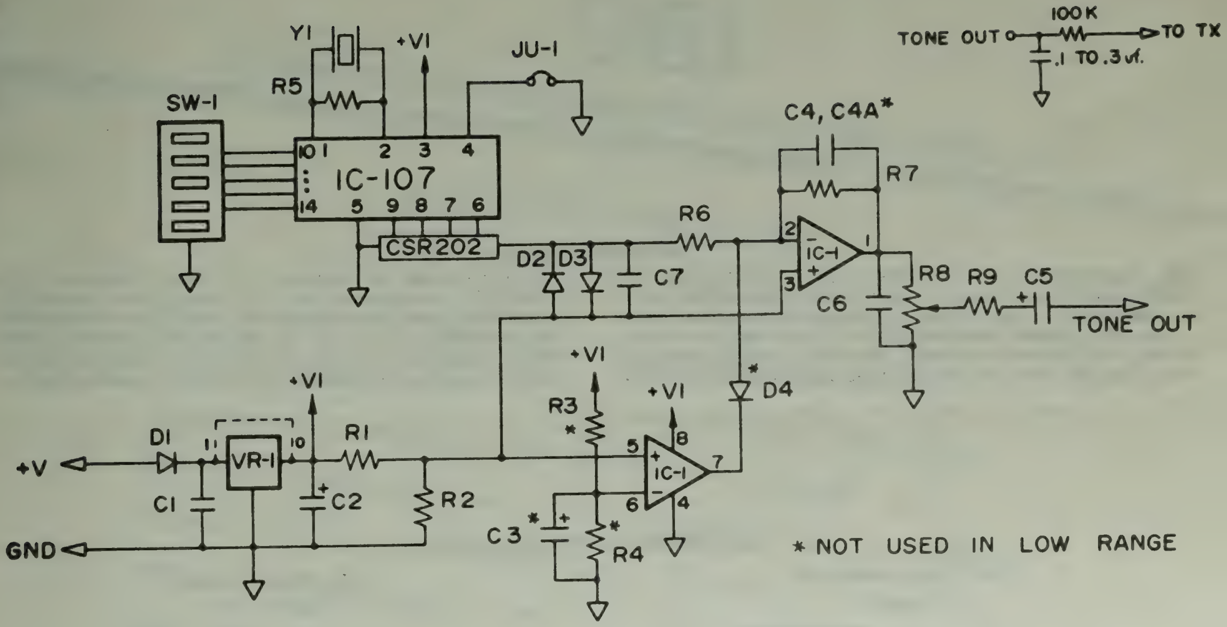
6. Replace the battery and key the transmitter. Measure the deviation and adjust VR3 for desired deviation. Keep VR3 as low as possible and the output of the SS-32 as high as possible.

7. Replace the front, screws, and the back.

NOTE:

1. Extra unwanted buzzing noises in the transmit audio indicate RF is getting into the SS-32 and then into the radio. Ferrite beads from Amidon seem to be the best solution. Short leads and good grounds also are helpful.

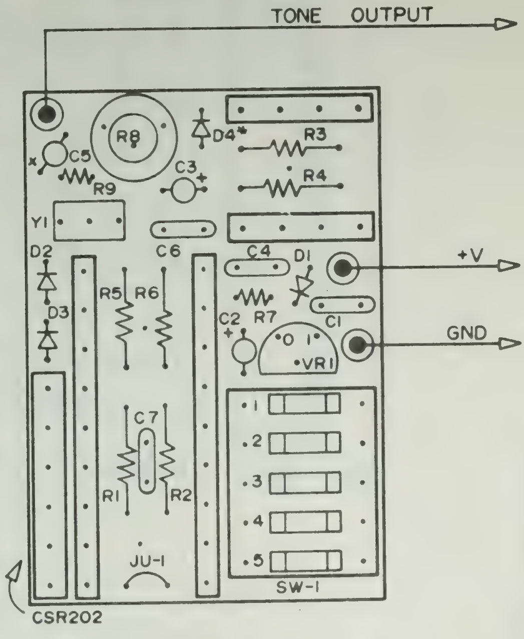
2. If you cannot successfully install the SS-32 yourself Encomm will do it for you for 1 hour labor charge.



SS-32 ENCODER PARTS LIST

R1 -	10K	1/8 watt	5%	resistor,	carbon	film	$.31 ea.
R2 -	9.1K	"	"	"	"	"	.31 ea.
•R3 -	470K	"	"	"	"	"	.31 ea.
•R4 -	1Meg	"	"	"	"	"	.31 ea.
R5 -	10Meg	"	"	"	"	comp.	.31 ea.
R6 -	15K	"	"	"	"	film	.31 ea.
R7 -	120K	"	"	"	"	"	.31 ea.
R8 -	5K	Mepco	pot				1.39 ea.
R9 -	1.2K	1/8 watt	5%	resistor,	carbon	film	.31 ea.
C1 -	.033uf	50v	CW15	capacitor,	mono.		1.75 ea.
C2 -	1uf	35v	tantalum	capacitor			1.05 ea.
•C3 -	1uf	"	"	"			1.05 ea.
C4 -	.01uf	50v	CW15	capacitor,	mono.		1.50 ea.
•C4A -	470pf	"	"	"	"		1.00 ea.
C5 -	1uf	35v	tantalum	capacitor			1.05 ea.
C6 -	100pf	50v	CW15	capacitor,	mono.		1.00 ea.
C7 -	100pf	"	"	"	"		1.00 ea.
D1 -	1N4148	silicon	diode				.15 ea.
D2 -	1N4148	"	"				.15 ea.
D3 -	1N4148	"	"				.15 ea.
•D4 -	1N4148	"	"				.15 ea.
Y1 -	1Mhz	crystal					7.50 ea.
VR-1 -	78L08A regulator						1.00 ea.
CSR202-	Resistor network						2.30 ea.
SW-1 -	5 position DIP switch						2.45 ea.
IC-107 -	Com-Spec microcircuit						17.50 ea.
IC-1 -	TL062 microcircuit						2.20 ea.
2 -	9 pin socket strips						.39 ea.
2 -	4 pin socket strips						.35 ea.
3 -	AMP chassis pins						.10 ea.
1 -	Printed circuit board						5.00 ea.
JU-1 -	Jumper wire						.01 ea.
	33 pos. binary switch (for remote operation)						9.95 ea.

•These items not used on sub-audible board.



* REMOVE FOR CONTINUOUS TONE

PROGRAMMING

This programmable line of products uses a five position DIP switch to select the frequency desired. When the switches are in any particular position, this binary code tells the integrated circuit which of the coded tones the system is to operate on. For instance, if 1Z (100.0Hz.) is desired, the code rquired is located on the instruction sheet and the switches are programmed accordingly. For example, the code for a 1Z is "11010", thus switch #1 is turned OFF (corresponding to a "1"), switch #2 is turned OFF, switch #3 is turned ON (corresponding to a "0"), switch #4 is OFF, and switch #5 is turned ON. By selecting the variable combinations of switch positions, all 32 tones can be accessed. Special tones are available also by using a different frequency crystal.

DIP SWITCH PROGRAMMING

FOR CTCSS PRODUCTS

GROUP A

			SWITCH NUMBER*				
#	FREQ.	CODE	5	4	3	2	1
1	67.0	XZ	0	0	0	0	0
2	71.9	XA	0	0	0	0	1
3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
6	82.5	YZ	0	0	1	0	1
7	85.4	YA	0	0	1	1	0
8	88.5	YB	0	0	1	1	1
9	91.5	ZZ	0	1	0	0	0
10	94.8	ZA	0	1	0	0	1
11	97.4	ZB	0	1	0	1	0
12	100.0	1Z	0	1	0	1	1
13	103.5	1A	0	1	1	0	0
14	107.2	1B	0	1	1	0	1
15	110.9	2Z	0	1	1	1	0
16	114.8	2A	0	1	1	1	1
17	118.8	2B	1	0	0	0	0
18	123.0	3Z	1	0	0	0	1
19	127.3	3A	1	0	0	1	0
20	131.8	3B	1	0	0	1	1
21	136.5	4Z	1	0	1	0	0
22	141.3	4A	1	0	1	0	1
23	146.2	4B	1	0	1	1	0
24	151.4	5Z	1	0	1	1	1
25	156.7	5A	1	1	0	0	0
26	162.2	5B	1	1	0	0	1
27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

FOR GROUP B TONES

REMOVE JU-1

		SWITCH NUMBERS*				
#	FREQ. (Hz)	5	4	3	2	1
1	600.0	0	0	0	0	0
2	1000.0	0	0	0	0	1
3	1500.0	0	0	0	1	0
4	1600.0	0	0	0	1	1
5	1650.0	0	0	1	0	0
6	1700.0	0	0	1	0	1
7	1750.0	0	0	1	1	0
8	697.0	0	0	1	1	1
9	1800.0	0	1	0	0	0
10	1850.0	0	1	0	0	1
11	1900.0	0	1	0	1	0
12	770.0	0	1	0	1	1
13	1950.0	0	1	1	0	0
14	852.0	0	1	1	0	1
15	941.0	0	1	1	1	0
16	2000.0	0	1	1	1	1
17	2100.0	1	0	0	0	0
18	2150.0	1	0	0	0	1
19	2200.0	1	0	0	1	0
20	2250.0	1	0	0	1	1
21	2300.0	1	0	1	0	0
22	2350.0	1	0	1	0	1
23	2400.0	1	0	1	1	0
24	1209.0	1	0	1	1	1
25	2450.0	1	1	0	0	0
26	2500.0	1	1	0	0	1
27	2550.0	1	1	0	1	0
28	1336.0	1	1	0	1	1
29	2175.0	1	1	1	0	0
30	1477.0	1	1	1	0	1
31	1633.0	1	1	1	1	0
32	2805.0	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

CES

COMMUNICATIONS ELECTRONICS SPECIALTIES INC.

INSTALLATION INSTRUCTIONS

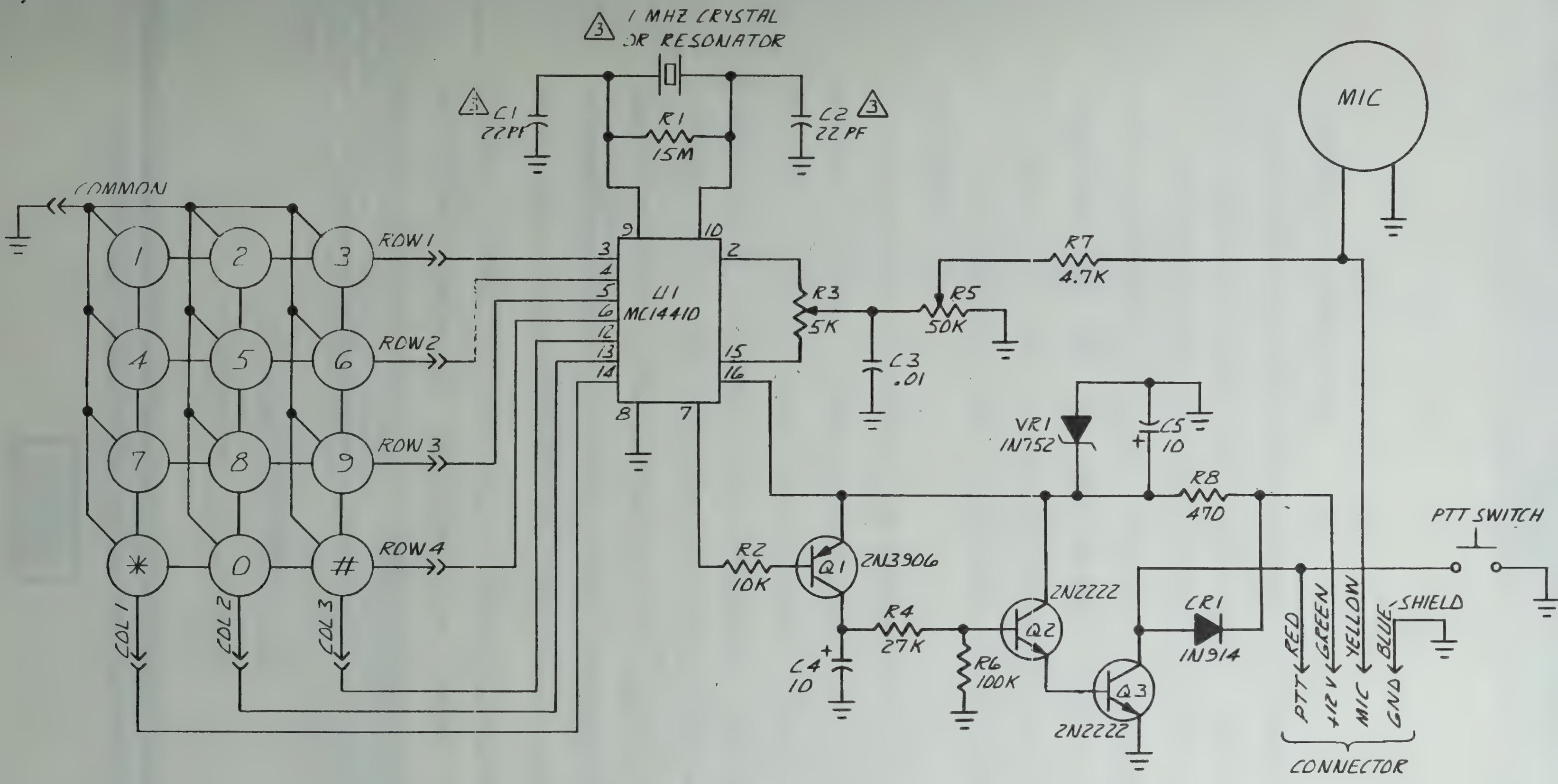
CES MODEL 230-A MICROPAD

To use the CES Model 230 on your transceiver, 12VDC must be wired to one of the pins on the transceiver microphone connector. If there is no unused pin on your mic connector, one can be installed in your transceiver with one additional pin. An easier method of connection that can be used on most transceivers is to remove the ground connection from the connector pin and connect 12V to that pin. The ground connection is then made through the shell of the connector. On some transceivers, the shield of the microphone cable is not connected to ground. Check your schematic to be sure of the proper wiring and install the proper connector on the Micropad.

Your new Model 230 is equipped with automatic PTT. It is not necessary to hold the push to talk switch when using the tone pad. If this feature is not desired, remove the orange wire from the back of the keyboard.

On some radios with solid state switching the automatic PTT may not function properly. If this problem is encountered the automatic PTT should be disabled by removing the orange wire.

399 W. Fairbanks Avenue Winter Park, Florida 32789
305/645-0474



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

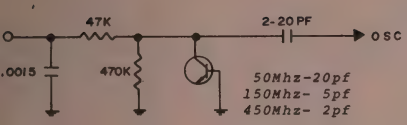
△3 WHEN 1 MHZ CRYSTAL IS USED C1 AND C2 ARE NOT REQUIRED.

SCHEMATIC DIAGRAM
MODEL 230-A

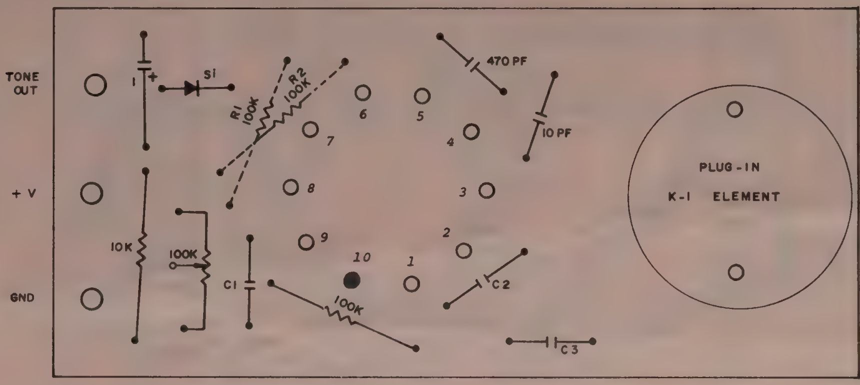
SIR SPEEDY 0071

Paul Grup
77

ME-3 MICROMINIATURE TONE ENCODER

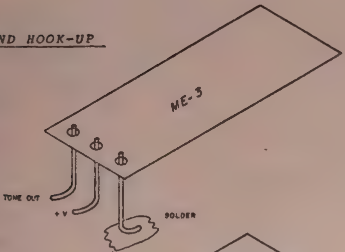


CRYSTAL MODULATOR CIRCUIT

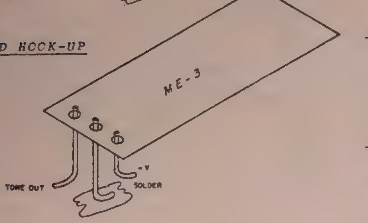


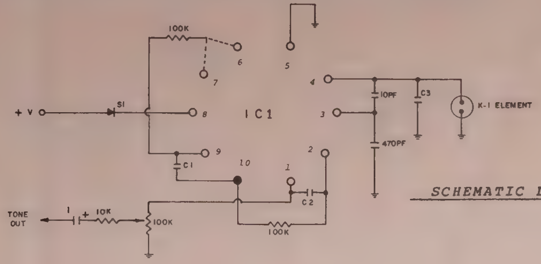
VIEW FROM COMPONENT SIDE BOARD

NEGATIVE GROUND HOOK-UP



POSITIVE GROUND HOOK-UP





SCHEMATIC DIAGRAM

MOUNTING

The unit is mounted with a 1/2w resistor lead (not supplied) about 1/2" long. Solder one end to the eyelet of the correct polarity desired. The other end of the lead is soldered to the PCB or chassis in the radio unit. See above diagram for correct hook-up. In portable units, the encoder may be insulated with tape or its equivalent and placed inside unit with no mounting. The unit is immune to RF.

POWER HOOK-UP

The voltage to the encoder MUST be keyed with the transmitter in most mobile units. This is because the encoder operates in the fundamental mode around the IF frequencies of some receivers. If keyed voltage is not available, an RF choke of 10uh to 100uh may be placed in series with the voltage supply to the encoder to eliminate the problem. Use the above diagram to apply correct polarity to the unit. If the polarity is reversed,the unit will not operate but it will NOT be damaged. If it is necessary to operate the encoder off supplies greater than 16vdc, use the following formula to determine the correct series dropping resistor value. R= Supply voltage-12 divided by .008. If "T" whine, vibrator hash, or AC hum are present in the tone output, add a 220 ohm 1/4w resistor in series with the supply lead and the encoder and bypass this point to the negative supply (or GND) with a 100uf-16v capacitor. For base operation in tube-type units, the -20v bias supply will provide adequate voltage with a 1k series dropping resistor.

TONE OUTPUT

Tone may be added to most transmitters directly to the center of the mod pot or directly to the modulator grid (or base in a transistorized transmitter). Note that a 10k series resistor is provided internally in the encoder so no other series resistance should be needed. If more tone level is required either the input voltage may be raised or this resistor may be jumpered across. Some older tube-type transmitters accept sub-audible tone more readily if injected with a crystal modulator circuit as shown above. Various values of coupling capacitance are shown for the different frequency ranges of the transmitter. The VARICAP (or transistor base to collector junction with the emitter cut off) changes ac voltage into changing capacitance which truely FM modulates the transmitter. No intermoding of distortion of the voice will be noted with this method.

GENERAL

Be sure to solder the eyelets to the foil on the PCB. If it is necessary to change tone frequency outside the band the unit was shipped on, see the list above for the proper band change parts values. Also note that C3 should be cut out (if it is present) anytime tone frequency is changed in the field. Any K-1 elements shipped for field replacement will NOT require C3. Band change parts may be ordered from the parts list for field changes in frequency. The entire encoder may be returned to the factory for a flat $7.00 charge which includes band parts change, new K-1 element, and return Air Mail postage. All encoders will be processed and shipped the same day received.

BAND CHANGE VALUES

67.0-131.8Hz	136.5-203.5Hz
.015uf	.01uf
NONE	NONE-56pf
IN	OUT
OUT	IN

PARTS LIST

1- 10k 1/8w	.25ea
2- 100k "	.25ea
1- 100k pot	1.75ea
1- 10pf CN15 "NPO"ceramic	1.00ea
1- 470pf " "	1.00ea
1- 4700pf CW15 "W" " C1	1.25ea
1- .01uf " " " C2	1.50ea
or .015uf " " " C2	1.75ea
1- 0-56pf CN15 "NPO" " C3	1.00ea
1- 1uf-35v tant. cap.	.85ea
1- Silicon diode	.15ea
1- Drilled,plated PCB	2.00ea
1- Microcircuit	15.00ea
1- K-1 element	3.00ea
2- Socket pins	.25ea

Price with K-1 element is $29.95. Extra K-1 elements are $3.00ea. Your PREPAID order will be sent POSTPAID by AIR MAIL or UPS the same day it is received. California residents supply resale number or remit 6% sales tax.

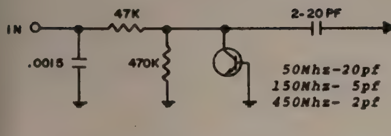
Send check or money order to:

COMMUNICATIONS SPECIALISTS
PO BOX 153
BREA, CALIF. 92621

(714) 998-3021

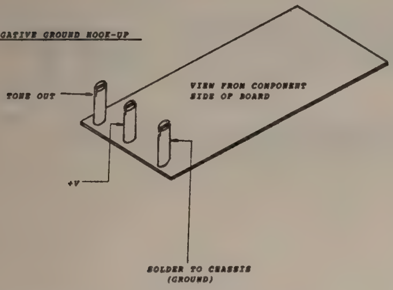
When ordering parts only, please remit an additional 75¢ to cover postage.

ME-3 MICROMINIATURE TONE ENCODER

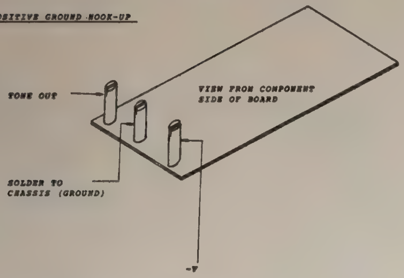


CRYSTAL MODULATOR CIRCUIT

NEGATIVE GROUND HOOK-UP



POSITIVE GROUND HOOK-UP

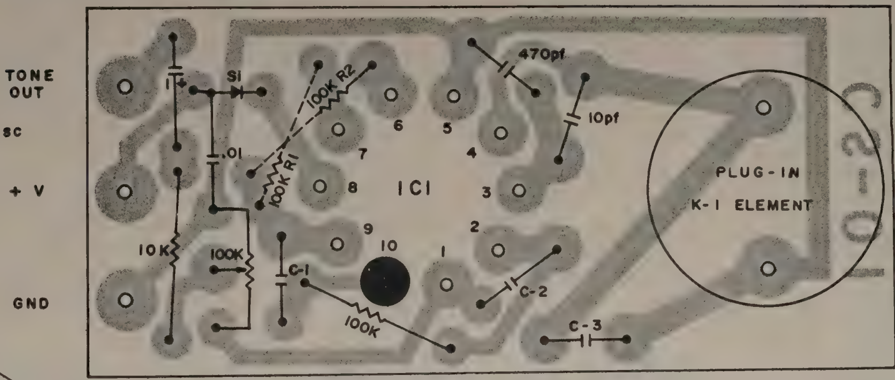


BAND CHANGE VALUES

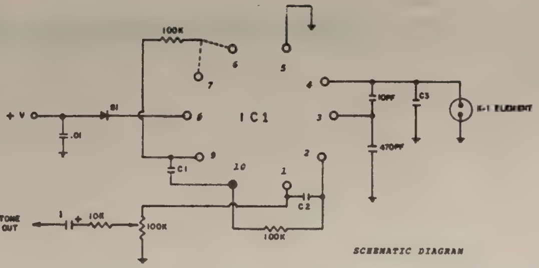
	67.0-131.8Hz	136.5-203.5Hz
C2	.015uf	.01uf
C3	NONE	NONE-56pf
R1	IN	OUT
R2	OUT	IN

PARTS LIST

1- 10k 1/8w	.25ea
2- 100k "	.25ea
1- 100k pot	1.75ea
1- 10pf CN15 "NPO"ceramic	1.00ea
1- 470pf " " "	1.00ea
1- 4700pf CW15 "W" " C1	1.25ea
1- .01uf " " " C2	1.50ea
or .015uf " " " C2	1.75ea
1- 0-56pf CN15 "NPO" " C3	1.00ea
1- 1uf-35v tant. cap.	.85ea
1- Silicon diode	.15ea
1- Drilled,plated PCB	2.00ea
1- Microcircuit	15.00ea
1- K-1 element	3.00ea
2- Socket pins	.25ea



VIEW FROM COMPONENT SIDE OF BOARD



SCHEMATIC DIAGRAM

MOUNTING

The unit is mounted with a 1/2w resistor lead (not supplied) about 1/2" long. Solder one end to the terminal of the correct polarity desired. The other end of the lead is soldered to the PCB or chassis in the radio unit. See above diagram for correct hook-up. In portable units, the encoder may be insulated with tape or its equivalent and placed inside unit with no mounting. The unit is immune to RF.

POWER HOOK-UP

The voltage to the encoder MUST be keyed with the transmitter in most mobile units. This is because the encoder operates in the fundamental mode around the IF frequencies of some receivers. If keyed voltage is not available, an RF choke of 10uh to 100uh may be placed in series with the voltage supply to the encoder to eliminate the problem. Use the above diagram to apply correct polarity to the unit. If the polarity is reversed,the unit will not operate but it will NOT be damaged. If it is necessary to operate the encoder off supplies greater than 16vdc, use the following formula to determine the correct series dropping resistor value. R= Supply voltage-12 divided by .008. If "T" whine, vibrator hash, or AC hum are present in the tone output, add a 220 ohm 1/4w resistor in series with the supply lead and the encoder and bypass this point to the negative supply (or GND) with a 100uf-16v capacitor. For base operation in tube-type units, the -20v bias supply will provide adequate voltage with a 1k series dropping resistor.

TONE OUTPUT

Tone may be added to most transmitters directly to the center of the mod pot or directly to the modulator grid (or base in a transistorized transmitter). Note that a 10k series resistor is provided internally in the encoder so no other series resistance should be needed. If more tone level is required, the input voltage may be raised to a level closer to 15vdc. Some of the older tube type transmitters accept sub-audible tone more readily if injected with a crystal modulator circuit as shown above. Various values of coupling capacitance are shown for the different frequency ranges of the transmitter. The VARICAP (or transistor base to collector junction with the emitter cut off) changes ac voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method.

GENERAL

Be sure the terminals are soldered to the foil. If it is nesessary to change tone frequency outside the band the unit was shipped on, see the list above for the proper band change parts values. Also note that C3 should be cut out (if it is present) anytime tone frequency is changed in the field. Any K-1 elements shipped for field replacement will NOT require C3. Band change parts may be ordered from the parts list for field changes in frequency. The entire encoder may be returned to the factory for a flat $7.00 charge which includes band parts change, new K-1 element, and return Air Mail postage. All encoders will be processed and shipped the same day received.

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Communications Specialists
426 W. Taft Ave., Orange, CA 92667
(714) 998-3021 (California) / (800) 854-0547

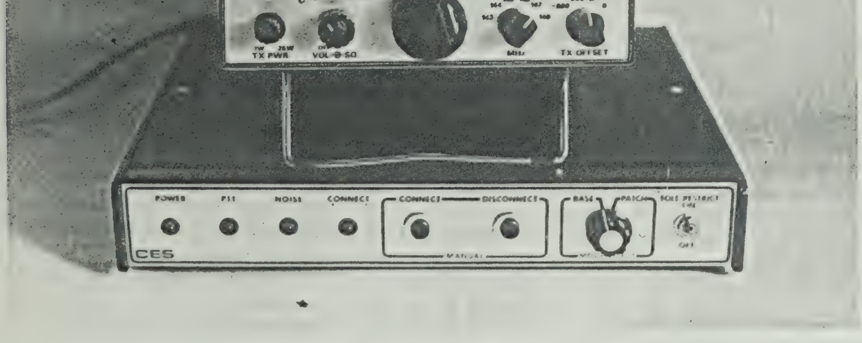
When ordering parts only, please remit an additional 75¢ to cover postage.

Paul Grupp KA1LR
73 Magazine Staff

The CES Simplex Autopatch

—some hot new hardware for two

One of the most controversial devices in a well-equipped repeater is its autopatch. Some hams use autopatch facilities frequently, as part of their daily life, while others are very uncomfortable with autopatch usage for routine communications. Many repeater groups permit their autopatch to be used only for emergency calls or set strict time limits for routine calls. Whatever your views on autopatching are, you have to admit that in congested areas where repeaters receive heavy use, autopatching can create problems. Users trying to carry on a conversation grow tired of being interrupted by people needing the patch, and many a stranded motorist has increased his blood pressure to dangerous levels while trying to break into a long-winded monologue to call for help.



CES Model 500SA *simplex autopatch.*

Communications Electronics Specialties, Inc., best known in amateur circles for their microphone-mounted tone pads and autodialers, has come up with a fascinating solution to the autopatch problem, the CES 500SA. The 500SA is a simplex autopatch unit which interfaces an amateur transceiver to a standard phone line. No cavities or other hardware are required. You access the patch just as you would access the patch on a repeater: "*" brings the patch up and "#" disconnects it from the phone line. Now if you think about this for a moment, you might get a little confused. How in the world can you operate an autopatch on a single frequency? It's not as difficult as it first seems.

How It Works

When the autopatch is not in use, it sits there waiting, patiently listening in the receive mode. When it receives a "*", it connects the patch to the phone line and switches the transceiv-

Orbit

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second sampling of the patch's receiver, you also have to be careful not to cut off the first part of a transmission, particularly when dialing. If you have a fancy tone pad or autodialer with automatic push-to-talk, you'll have to forego the pleasures of that particular feature. Good operating practice with a simplex autopatch requires the transmitter to be keyed a couple of seconds before the first tone is sent, to allow the patch's logic to lock into the receive mode.

The 500SA is equipped with a time-out timer that gives warning beeps after 80% of timeout. The timer can be programmed to reset with a carrier, a "*", or no reset at all. Our unit was programmed to reset with a "*", which seems a good compromise.

One feature of the 500SA that you may not wish to use is its reverse autopatch capability. When someone calls the autopatch, it transmits a beep to let you know that a call is waiting. If you wish to talk to the caller, you simply press the "*" on your tone pad to connect the phone line to the patch. Since this system does not allow a control operator to screen the call before the caller goes on the air, it is doubtful that the reverse autopatch function is legal under present FCC rules and regulations. If you choose not to use this feature, it is easily disabled.

Legal Considerations

Many people I have talked with about the simplex autopatch have questioned the system's legality. After several phone calls to the FCC, I came to the conclusion that within the following limitations, the 500SA is legal. For any autopatch to be legal, simplex or otherwise, a control operator has to be present at a control point for the transmitter. This rather dashes any hopes of simply plugging the thing in at home and having your own private autopatch. A ham will either have to be present in the room with the patch, or you'll have to arrange a control link to turn the patch on and off that is independent of the input frequency of the patch. If you monitor the patch whenever it is up and can shut the thing down if a wild turkey brings up the system, you'll be well on your way to being legal.

The other thing you'll need if you want to be legal is an IDer. CES offers one as an option for the 500SA, and at about 50 dollars, it's well worth the investment. The reverse autopatch feature? As mentioned above, the legality of reverse autopatch is doubtful at best, so you might as well disable that feature right away.

Applications

So how is the average ham going to use the 500SA? Well, the possibilities are almost endless! You could just plug the thing in at a good site and hope that the FCC never catches you operating it without a control operator. That's just asking for trouble, and besides, there are some far more intriguing possibilities that are still within the capabilities of an individual ham.

Install the 500SA at a good site, hook up a 220- or 430-MHz control receiver, and bring in a phone line. Designate anybody you wish as a control operator, and leave the patch normally disabled. Whenever one of the control operators wants to use the patch, he or she can activate it via the control link and then use it normally. This has the advantage of giving instant accessibility, yet it stays well within the letter and intent of the law.

The only disadvantage is that you need to have a transmitter for 220 or 430 as well as two meters to use the patch, since control functions cannot be performed on two meters. The obvious solution is to put both the patch and its control receiver on the same band, say 220 MHz. Install a 220-MHz transceiver in your car or use a handheld, and the one rig can handle both control and operating functions. Dial in the control frequency, bring up the patch, and then flip to the patch's operating frequency to place your call.

This approach seems ideal for the individual or small group with a closed system in mind. If the group grows or decides to make its facility available on an open basis, the patch could be left on all the time, as long as a control operator is monitoring the frequency.

Conclusions

However you use it, the CES 500SA is a versatile and innovative new product. The concept is a logical one, and CES has produced an autopatch system that should give dependable, trouble-free operation at a fraction of the cost of a repeater and its associated autopatch equipment.

If you or your group has ever wanted to have an autopatch system, as a convenience or for emergency use, you owe it to yourself to check out the CES 500SA!

For further information, contact *Communications Electronics Specialties, Inc., 260 W. New England Avenue, Winter Park FL 32789.* Reader Service number 478. ■

er over to transmit. You hear a dial tone just as you would with a normal autopatch, with one important difference. Once per second, the patch samples its receiver for a "window" of anything from 5 to 100 milliseconds, depending on the squelch characteristics of the receiver. If there is a carrier present during this sampling window, the logic locks the system in the receive mode and doesn't switch back to transmit until the carrier drops. This ensures that the party on the other end of the phone line can't capture the transmitter.

It doesn't take much of an imagination to conclude that the constant switching between receive and transmit will be audible, and indeed it is. *How* audible it is depends on how long it takes the autopatch's transceiver to switch from transmit to receive and back again, and how good the squelch is on the transceiver you use to access the patch. CES provides information on how to modify your own transceiver to work with the patch, or they will sell you a Clegg FM-88 synthesized two-meter transceiver that is already modified. The most important change required for a transceiver to work with the 500SA is a simple mod that allows the receiver to stay on all the time. Using the modified Clegg FM-88 on the patch end and a standard Kenwood TR-7600 in the car, we found that the sampling window is audible, but never interferes with intelligibility. The sampling window makes the 500SA sound different than repeater autopatches, but in practice it works just as well.

In the past, some hams have put together systems that used a VOX circuit and stayed in the transmit mode whenever the person on the telephone was talking. When they stopped talking, the system switched back to receive, allowing the ham to talk. These systems were *not* legal. The person on the other end of the phone line was clearly in control of the transmitter, and if that person chose to talk about things that made you uncomfortable, you and every other ham on frequency had no choice but to listen. With the CES system, the ham is in control of the autopatch transmitter, because he can cause the patch's transmitter to shut down whenever he chooses, in one second or less.

Advantages of Simplex Autopatch

The advantages of a simplex autopatch are pretty obvious, but they are worth mentioning anyway. First of all, the patch only occupies one frequency, rather than a pair. In our increasingly congested amateur allocations, this becomes an important consideration. The ability to use a normal synthesized transceiver with the patch is positively enticing. Since the costs involved are negligible compared to a complete repeater, an individual or small group could easily put such a system on the air, or a repeater group could move autopatching activities off the repeater and onto a simplex frequency, freeing the repeater for normal QSOs.

A simplex autopatch could be extremely useful in an emergency situation when telephone communications fail. Just plug the 500SA into the phone system outside of the affected area, and police, fire, and medical teams can be given access to the phone system.

As it is presently configured, the 500SA cannot be accessed through a repeater, but the manufacturer is developing some modifications to allow that use. Many repeaters are located in remote areas where it is impossible to bring in a phone line, and the 500SA could provide autopatch facilities for these systems.

While the concept of a simplex autopatch is revolutionary, it is only fair to mention that a similar system is presented in Bill Pasternak's and Mike Morris's epic tome, *The Practical Handbook of FM and Repeaters*, and has probably been discussed elsewhere as well. Simplex autopatches have been in use for several years, but the introduction of this commercially-built unit by CES will certainly increase the popularity of the simplex autopatch. With no further ado, let's take a good look at the 500SA.

Description

Physically speaking, there isn't much to the 500SA. It is a well-finished metal box that measures 1-1/2 inches high by 9 inches deep by 10-1/2 inches wide. The front panel is a model of simplicity. On the far right-hand side is a toggle switch marked "Toll Restrict," and it does just that. Inside the patch is a circuit board with 10 spaces available for the insertion of diodes. Our unit had diodes in the "0" and "1" slots. Numbers starting with a 0 or 1 are consequently ignored by the decoder when the Toll Restrict switch is on.

Next to the Toll Restrict switch is a two-position rotary switch marked "Base" and "Patch". This allows you to completely bypass the patch electronics and use the transceiver as a normal base station. Next to this switch are two momentary-contact push-buttons marked "Disconnect" and "Connect" for manual testing of the patch. The last item sharing the front panel is a row of LEDs, to keep you informed of the status of the system's various functions.

Inside, construction is uniformly excellent. The glass-epoxy circuit board, high-quality components, and careful layout all serve as reminders that CES produces a wide range of equipment for the commercial radio services.

Moving to the back of the patch, we find a neatly grommeted hole with telephone wire exiting it. The wire is equipped with a standard modular phone plug, so interfacing the patch to the phone line is not traumatic. Also on the rear panel are two multi-pin connectors for interfacing the unit with transceiver and IDer.

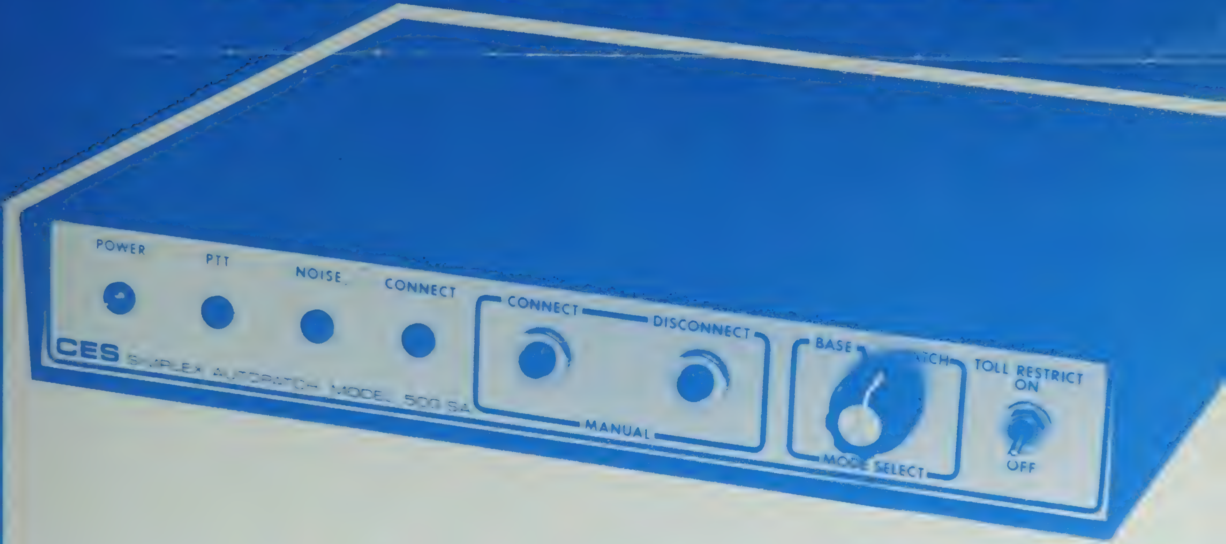
Installation and Use

We used a modified Clegg FM-88 as the transceiver for the patch, and setting up the system couldn't be simpler. CES thoughtfully wired up all the necessary functions to the accessory socket of the Clegg and provided an interface cable as well. Installation consequently took less than five minutes and consisted of hooking up the transceiver to a 12 V dc power supply, an antenna, and the autopatch, and plugging the autopatch into a phone jack. Power is supplied to the patch through the interface cable from the transceiver. The patch can be configured to work with either pulse or touchtone™ phone systems; touchtone is a far-off dream in our area, so we had the optional pulse dialer installed.

Operation of the simplex autopatch is even less challenging than its installation. As with any phone interconnect system that is not full duplex, you have to remind people that if they talk at the same time you're talking, you won't hear them. Because of the once-per-

CES

500SA CONTROL/BASE STATION AUTOPATCH



State of the art Simplex Autopatch providing positive radio operator control. Telephone VOX Circuits are eliminated by the unique CES Noise-gated sampling circuit.

THE CES

Now, mobile operators can enjoy the unmatched flexibility of an affordable, private phone patch for the first time.

The CES 500SA is packaged with all of the equipment necessary to patch an F.M. base station with any standard telephone (or two wire system). Absolutely no expensive repeater-style equipment is required!

Suggested applications for the Model 500SA:

- Mobile/remote base to telephone line via Simplex base
- Mobile to mobile via telephone interconnected base stations for extended range
- Telephone line to mobile/remote base

Some of the outstanding features of the Model 500Sa include:
Simple base station equipment. Requires only an FM transmitter/receiver or transceiver. No repeater type equipment (duplexers, etc.) is required.

Base station equipment remains fully operable as a base station. The front panel switch selects base or patch mode.

May be operated on **any simplex frequency or frequency split,** including repeater off sets.

Self-contained tone (DTMF) decoder for * up, # down and toll restricts logic.

Toll restrict logic disconnects phone line when first number dialed is disallowed. One or more numbers (0 thru 9) may be user-programmed for this function, using plug-in diodes.

Front panel toll restrict on-off switch (standard).

The radio operator must remember to hesitate slightly after pressing the PTT switch before speaking or sending tones. Hesitation is required because the autopatch operates with a receiver sampling technique. The receiver is normally in the receive mode. When a "connect" tone is received, the patch logic closes the PTT line and enables the ID'er (if installed). When the ID sequence is complete, the phone line is connected and phone line audio (dial tone, or incoming call) is transmitted.

500SA AND CLEGG RADIO

500SA SYSTEM

Patch logic then enters the sampling mode, which repeatedly opens the PTT line at a sampliig rate of about once per second (onboard control provides adjustment of sample rate). If there is no incoming signal, receiver noise is detected and the PTT line is immediately closed, returning the station to transmit. If an incoming carrier is detected, patch logic holds the PTT line open and receiver audio is routed to the tone decoder and the phone line. This technique provides positive control to the mobile or remote base operator. Control can be seized within a time period not longer than one sample perod.

Most FM transmitter/receiver units or transceivers can be easily modified to operate with the Model 500SA autopatch while maintaining full base station capability. Only seven simple connections are required within the radio (+12 volts, ground, speaker audio out, speaker audio in, microphone audio in, PTT ground in, and squelch noise amplifier signal voltage out).

A pre-assembled, eight-wire cable with plug for direct plug in to the Model 500SA and a modular telephone cord are provided.

The CW identifier is a plug-in option using a factory programmed memory chip to generate call letters. The memory chip plugs into an IC socket. The ID'er is supplied with an installed chip programmed with the customer's specified call sign. Additional programmed chips are available at a nominal cost for plug in call sign modifications.

Adjustable time-out timer is resettable during any part of the timer cycle via user-selected functions (onboard strap) of * tone or carrier received.

Time out warning beeper provides a warning when approximately 75% of selected time-out period has expired.

Smart CW identifier automatically enables transmitter and identifies when a "Connect" tone is received before connecting phone line. When a "Disconnect" tone is received, or a time-out occurs, the ID follows the phone line disconnect.

Phone ring detection logic enables CW identifier for one only ID sequence for each call received. A three-second tone pulse is transmitted if ID board is not installed.

Optional dial pulse converter converts received tones (DTMF) to dial pulses for rotary telephone systems

Operation of the base station autopatch is identical to the operation of a repeater autopatch — with the exception of a repetitive squelch tail noise, heard in the mobile or remote base receiver.

This sound does not interfere with understanding receiver audio and is not audible on the telephone line.

ALSO AVAILABLE FROM

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COMMUNICATIONS ELECTRONICS SPECIALTIES INC.

MODEL 500SA INTERCONNECT

INTRODUCTION

The CES Model 500SA is a simplex telephone interconnect, requiring only a simplex transceiver at the base station. The unit functions using a sampling technique, giving the mobile operator full control at all times.

When the base transmitter is on, it is switched off for a very short time at 1-second intervals to determine if the mobile is transmitting. If the mobile is transmitting, the base transmitter stays off to allow the mobile unit to talk. When the mobile transmitter drops, the base will resume transmitting and sampling.

The unit will work with any transceiver. However, the duration of the sample window required, is determined by the time required for the transceiver to switch from transmit to receive and back to transmit. This could be as much as 100ms for some transceivers. There are simple modifications that can minimize the transceiver switching time. Transceivers with solid state switching are recommended.

An adjustable time-out timer is used that will transmit warning beeps after 80% of the selected time. The timer can be strapped to reset with either the * or the mobile carrier or not resettable at all.

The patch operates the same as any other auto-patch with one exception. When the patch is up, the sampling windows will be audible. At the beginning of each mobile transmission, the user must pause for at least the time between sample windows before dialing, or the first digit may not be received. The connect code is * and the disconnect is #.

260 W. New England Avenue Winter Park, Florida 32789
305/645-0474

INSTALLATION

TRANSCEIVER MODIFICATIONS

There are seven connections that must be made between the 500SA and the transceiver. These connections can usually be made through the transceiver's accessory jack. Some existing connections on the accessory jack may have to be removed. If an accessory jack is not available, a hole can be drilled and a cable permanantly installed. The connections that must be made are as follows:

Black	Ground
Red	+12VDC
Green	Speaker Audio
White	Speaker Audio Return
Blue	Mic Audio
See Note	PTT
Yellow	Noise

NOTE: If the transceiver is solid state switching, use the orange wire. If the transceiver is relay switching, use the brown wire.

Connect the black wire of the cable to a good ground and the red wire to +12VDC.

Remove the audio wire from the speaker (the speaker wire that does not go to ground) and connect it to the green cable wire. Connect the white wire to the speaker.

Connect the blue wire to the mic input.

Connect either the orange or gray wire to PTT (see note above).

The yellow wire connects to the output of the noise amplifier just in front of the squelch rectifier. To locate the noise amplifier, first locate the squelch control on your schematic. The squelch control will be connected either just in front of or just behind the noise amplifier. Behind the noise amplifier, there will be a circuit consisting of two diodes and one or two capacitors. This is the squelch rectifier.

OPTIONAL TRANSCEIVER MODIFICATIONS

The following modifications will improve the switching speed of the transceiver and therefore shorten the required sample window; however, they are not necessary for proper operation.

Remove the receiver power connections from the PTT switching circuit and connect them to unswitched +12V. This keeps the receiver on at all times.

Supplied with the 500SA, is a power transistor. Connect the transistor as follows:

Black	to	Ground
Green	to	PTT
Red	to	Switched Transmitter Power (+12V)

This shortens the turn-off time of the transmitter.

CAUTION: Be sure there is a proper fuse in the power supply cord to the transceiver.

ADJUSTMENTS

NOTE: Refer to the assembly drawing to locate all of the following adjustments.

NOISE Switch the 500SA for base operation and adjust the transceiver squelch control for critical squelch.

Switch to patch operation and adjust the VRI, the Noise Level adjust, to light the noise LED on the front panel, to approximately one half the brightness of the power LED.

SAMPLE RATE The Sample Rate has been factory adjusted for one sample per second; however, it can be re-adjusted to any rate you desire.

SAMPLE TIME	To adjust the Sample Time, you will need someone to transmit on your frequency. Push the connect button. The connect and PTT LEDS should light and you should hear a relay clicking. Turn the Sample Time adjust fully counterclockwise. The relay will stop clicking. Now have someone transmit. Turn the Sample Time adjust clockwise until the PTT light goes out, then turn it a little farther. When the remote transmitter drops, the PTT LED will come back on.
TIMEOUT TIMER	The Timeout Timer can be adjusted from 30 seconds to 6 minutes.
RECEIVE LEVEL	The Receive Level adjusts the level of the audio into the telephone line. It will also depend on the setting of the volume control on the transceiver. To make this adjustment, start with the volume control setting of 1/3.
DECODER INPUT LEVEL	Set the control on zero and push the connect button. Have someone transmit while pushing their # button. Increase the level until a disconnect occurs, then set the control at double that reading.
TRANSMIT AND BEEPER LEVEL	Simply adjust for adequate transmitter deviation.
TIMER RESET	The unit is shipped with the timer strapped to reset with the * (A position). To reset each time mobile carrier is on, clip the existing jumper and install a jumper at the B position. With the jumper in the C position, the timer cannot be reset.

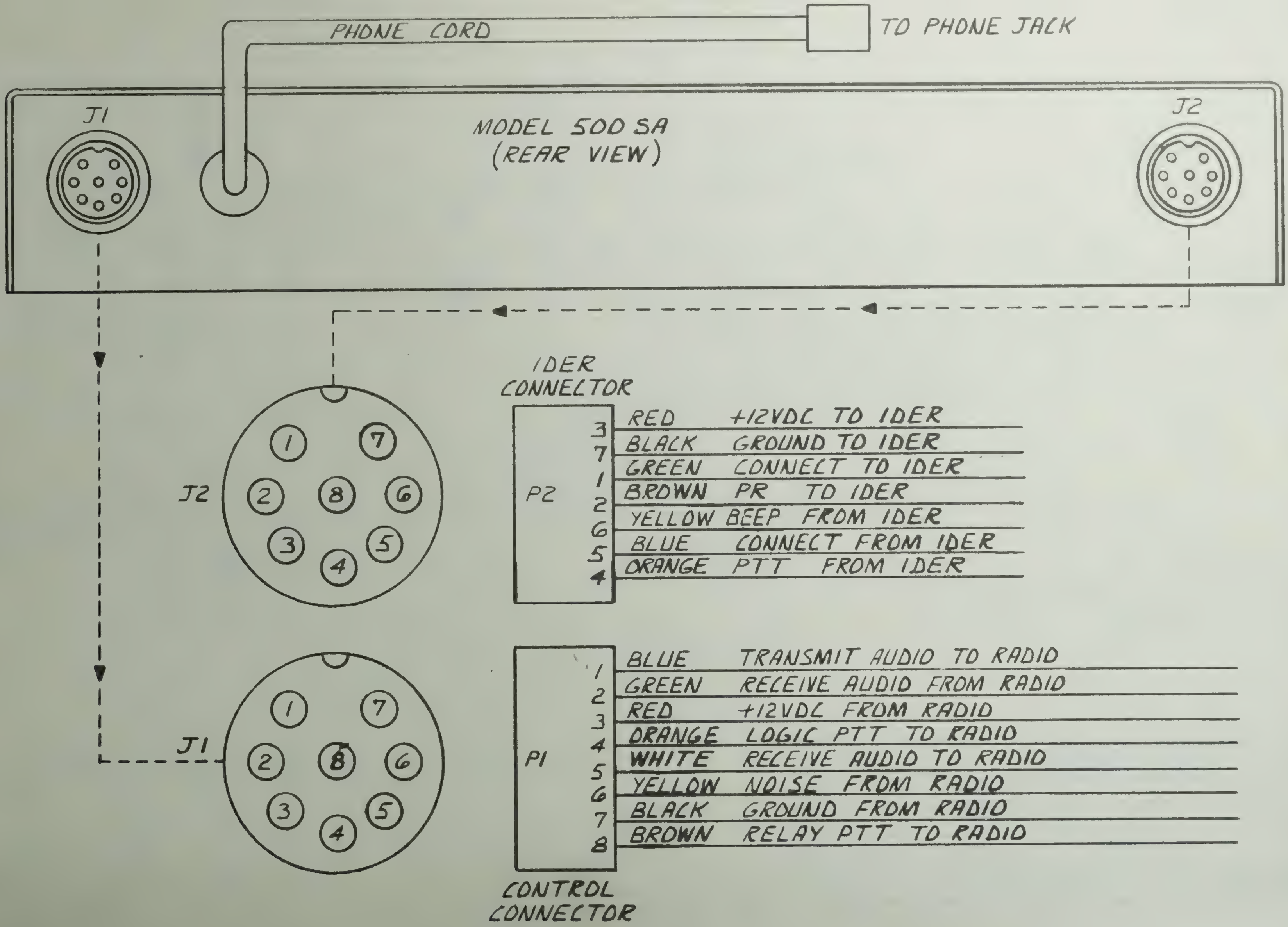
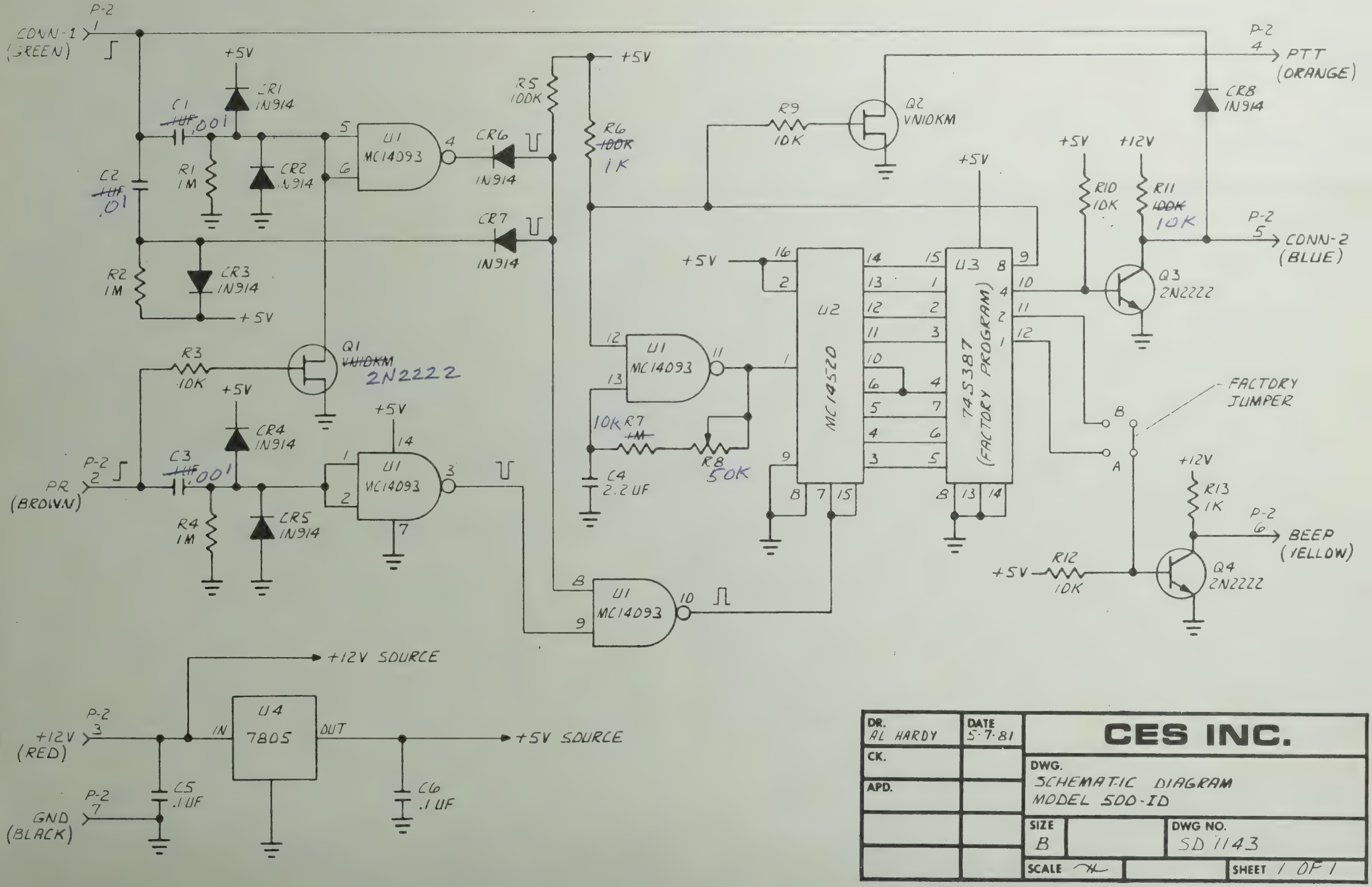
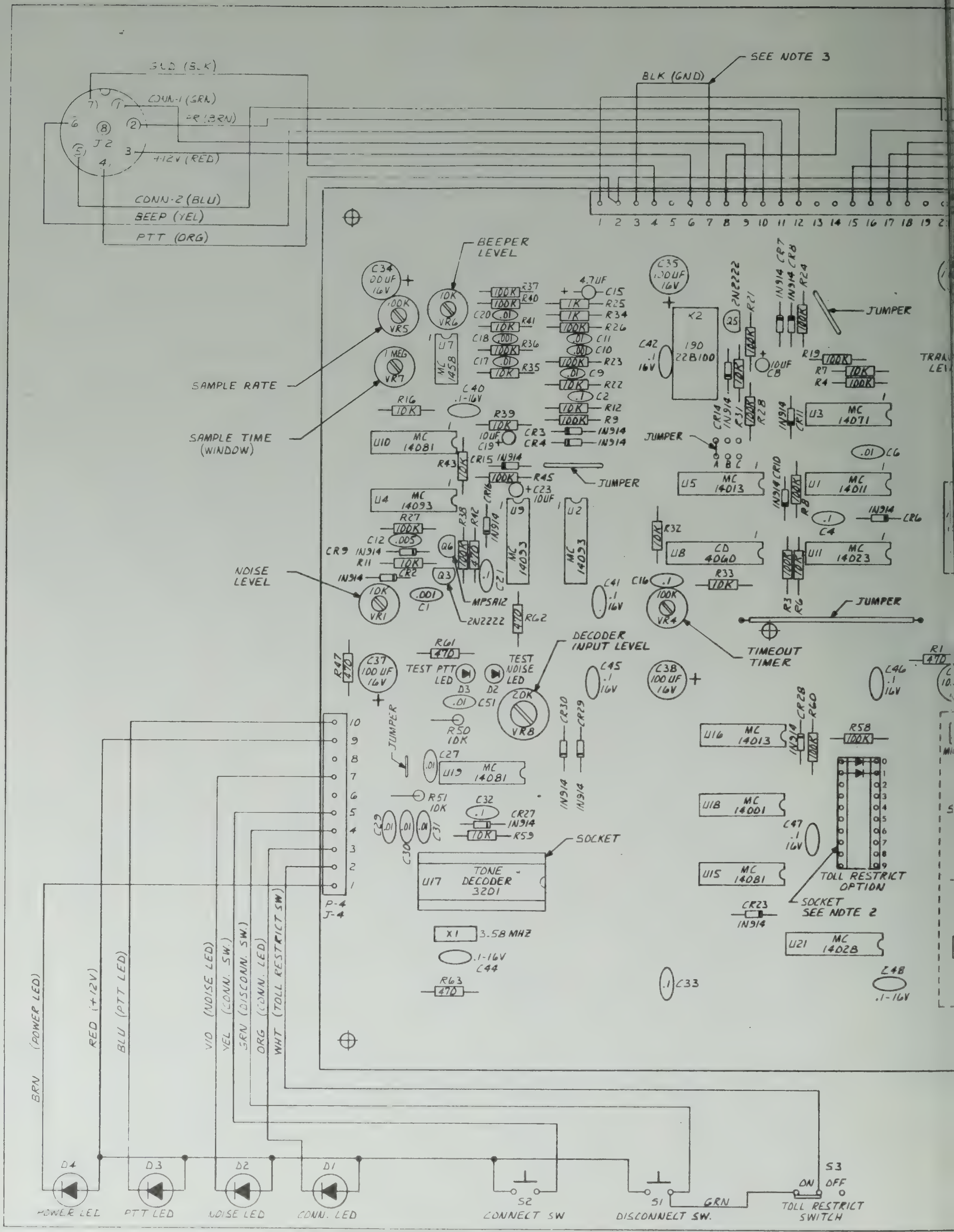

PHONE CORD
TO PHONE JACK
J1
MODEL 500 SA
(REAR VIEW)
J2
IDER
CONNECTOR
J2
1
7
2
8
6
3
5
4
P2
3 RED +12VDC TO IDER
7 BLACK GROUND TO IDER
1 GREEN CONNECT TO IDER
2 BROWN PR TO IDER
6 YELLOW BEEP FROM IDER
5 BLUE CONNECT FROM IDER
4 ORANGE PTT FROM IDER
J1
1
7
2
8
6
3
5
4
P1
1 BLUE TRANSMIT AUDIO TO RADIO
2 GREEN RECEIVE AUDIO FROM RADIO
3 RED +12VDC FROM RADIO
4 ORANGE LOGIC PTT TO RADIO
5 WHITE RECEIVE AUDIO TO RADIO
6 YELLOW NOISE FROM RADIO
7 BLACK GROUND FROM RADIO
8 BROWN RELAY PTT TO RADIO
CONTROL
CONNECTOR

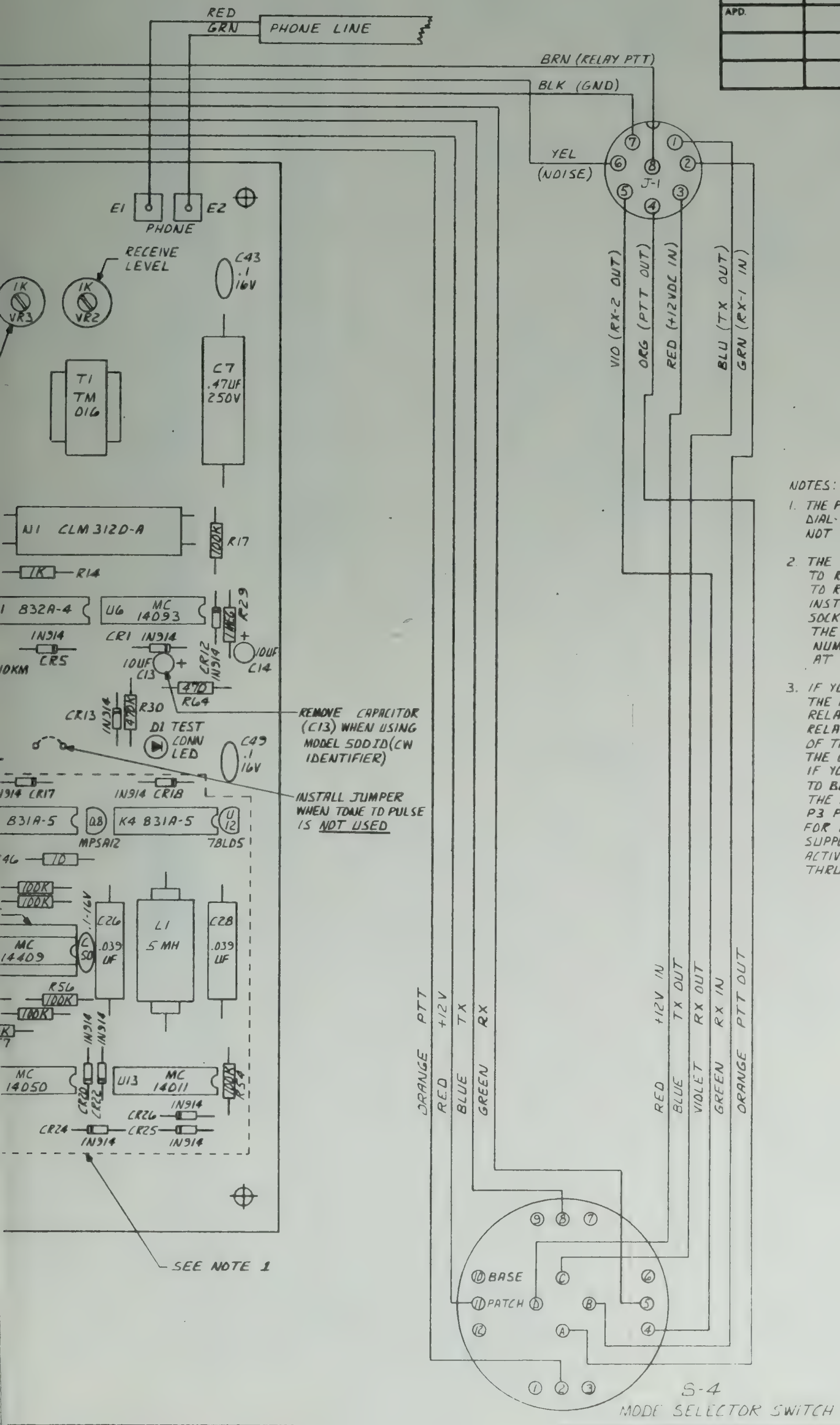
FIGURE 1



DR. AL HARDY	DATE 5-7-81	CES INC.	
CK.		DWG. SCHEMATIC DIAGRAM MODEL 500-ID	
APD.			
		SIZE B	DWG NO. SD 1143
		SCALE ~~/~~	SHEET 1 OF 1


GND (BLK)
CONN-1 (GRN)
PR (BRN)
+12V (RED)
CONN-2 (BLU)
BEEP (YEL)
PTT (ORG)
J2
SEE NOTE 3
BLK (GND)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
BEEPER LEVEL
SAMPLE RATE
SAMPLE TIME (WINDOW)
NOISE LEVEL
C34 100UF 16V
100K VR5
10K VR6
1 MEG VR7
U7 MC 1458
R37 R40 C20 R41 C18 R36 C17 R35
4.7UF C15
R25 R34 R26 C11 C10 R23 C9 R22 C2 R12 R9
CR3 CR4 1N914
C40 .1-16V
R16 10K
R39 10UF C19
U10 MC 14081
R43 CR15 1N914 R45 C23 10UF
JUMPER
U4 MC 14093
R27 100K
C12 .005
CR9 1N914 R11 10K
1N914 CR2
Q6 Q3 R38 R42 CR16
U9 MC 14093
U2 MC 14093
C21
MPSA12
2N2222
VR1 10K
C1 .001
RG2 470
C35 100UF 16V
K2 190 22B100
C42 .1 16V
2N2222 Q5
R21 CR14 1N914 R31 R28
1N914 CR7 1N914 CR8 R24
10UF C8
R19 100K
R7 10K
R4 100K
U3 MC 14071
CR11
JUMPER A B C
U5 MC 14013
U1 MC 14011
CR10 R8
C4 .1
1N914 CR6
R32 10K
U8 CD 4060
U11 MC 14023
C41 .1 16V
C16 .1
VR4 100K
R33 10K
R3 R6
TIMEOUT TIMER
TRA LEV
DECODER INPUT LEVEL
R47 470
C37 100 UF 16V
R61 470
TEST PTT LED D3
TEST NOISE LED D2
C51 .01
C45 .1 16V
C38 100 UF 16V
20K VR8
CR30 CR29 1N914
R50 10K
C27 .01
U19 MC 14081
R51 10K
C32 .1
CR27 1N914
R59 10K
C29 C30 C31 .01
SOCKET
U17 TONE DECODER 3201
X1 3.58 MHZ
C44 .1-16V
R63 470
C33 .1
R1 470
C46 .1 16V
U16 MC 14013
CR28 R60
R58 100K
U18 MC 14001
C47 .1 16V
U15 MC 14081
TOLL RESTRICT OPTION
SOCKET SEE NOTE 2
CR23 1N914
U21 MC 14028
C48 .1-16V
P-4 J-4
1 2 3 4 5 6 7 8 9 10
BRN (POWER LED)
RED (+12V)
BLU (PTT LED)
VIO (NOISE LED)
YEL (CONN. SW.)
GRN (DISCONN. SW.)
ORG (CONN. LED)
WHT (TOLL RESTRICT SW.)
D4 POWER LED
D3 PTT LED
D2 NOISE LED
D1 CONN. LED
S2 CONNECT SW
S1 DISCONNECT SW.
GRN
S3 ON OFF TOLL RESTRICT SWITCH

DR. A.L. HARDY	DATE 4-6-81	**CES INC.**		
CK.		DWG. ASSY DWG SIMPLEX INTERCONNECT MODEL 500SA		
APD.				
		SIZE D	DWG NO. AS1142SA	REV A
		SCALE 2:1		SHEET 1 OF 1



REMOVE CAPACITOR (C13) WHEN USING MODEL 500ID (CW IDENTIFIER)

INSTALL JUMPER WHEN TONE TO PULSE IS NOT USED

SEE NOTE 1

S-4
MODE SELECTOR SWITCH

NOTES:

1. THE PARTS WITHIN DOTTED LINES ARE FOR DIAL-PULSE DIALING. IF THIS OPTION IS NOT ORDERED, THE PARTS ARE NOT INSTALLED.
2. THE TOLL RESTRICT SOCKET IS AVAILABLE TO RESTRICT LONG DISTANCE DIALING. TO RESTRICT THE FIRST DIGIT NUMBER, INSTALL A SMALL SIGNAL DIODE IN THE SOCKET LOCATION CORRESPONDING TO THE NUMBER YOU WANT TO RESTRICT. NUMBERS 0 AND 1 ARE RESTRICTED AT THE FACTORY.
3. IF YOUR RADIO USES A RELAY TO SWITCH THE ANTENNA, READ THE FOLLOWING NOTE. RELAY K2 IS SUPPLIED TO OFFER PTT TO RELAY SWITCHING TRANCEIVERS. ONE SIDE OF THE RELAY IS CONNECTED TO J1 PIN 8, THE OTHER SIDE IS GROUNDED TO P3 PIN 3. IF YOUR TRANCEIVER REQUIRES IT'S RELAY TO BE ACTUATED WITH A + VOLTAGE, REMOVE THE END OF THE BLACK WIRE CONNECTED TO P3 PIN 3 AND RECONNECT IT TO P3 PIN 5. FOR ELECTRONIC SWITCHING WE HAVE SUPPLIED AN OUTPUT ON J1 PIN 4, WHEN ACTIVATED THIS OUTPUT IS GROUNDED THRU A TRANSISTOR.

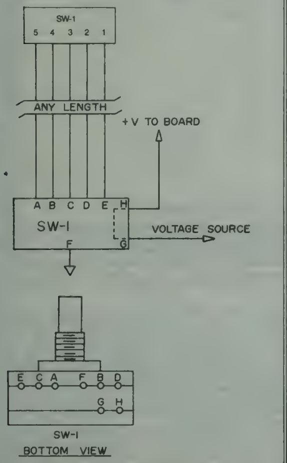
MULTI-TONE APPLICATIONS

By adding a little additional circuitry, our programmable line of products may be frequency programmed by remote means. Since these products all use DC signals for switching, any number of tones may be switched in or out without being concerned with additional lead length, or stray capacitance affecting the frequency. This is a typical problem associated with tunable or reed type units.

There are a number of ways of changing frequencies from a remote location. The easiest way is to use a 33 position binary switch (available from us) which connects in parallel with the 5 position DIP switch on the circuit board. Thus all 32 tones may be accessed by rotating through all positions on the switch, with the first position on the switch being the off condition (see figure M1). When connections are made in this manner, position ONE will be the off condition, and the path from "G" to "H" will be open thereby removing power from the programmable board. Position TWO would be 67.0Hz (Group A), position three would be 71.9Hz, and so on up to position 33 which would be 203.5Hz. When using the binary switch be sure all five positions on the DIP switch are in the **OFF** condition.

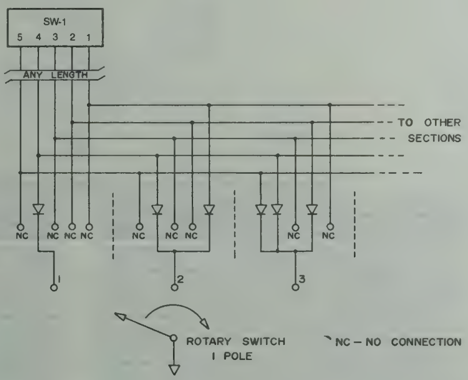
The other method for adding additional frequencies is to use a single pole rotary switch with as many positions as the number of different frequencies required. Using this method, a diode for line isolation must be used in each leg of the program code which requires a "0" or a ground for programming (see figure M2). In this example, three frequencies are required to operate a three site repeater system. The sub-audible tones required to access all three sites are 5Z (151.4Hz), 4B (146.2Hz), and YZ (82.5Hz). The frequency code is located on the programming chart for each of the three frequencies and these codes are converted to the appropriate diode array for each frequency. For example, position number two on the rotary switch must be 146.2Hz. This corresponds to "01101" on the program chart. By looking at this code, it is determined that 2 diodes will be required on the locations containing a "0", and no connection is required in the locations containing a "1". Thus the lines from pin 1, and pin 4, on SW-1 are pulled to ground through the series diodes when the rotary switch is in position number two. This method works quite well where space is a factor, and is best when only a few frequencies are required. Be sure all five positions on the DIP switch are in the **OFF** condition when changing frequencies remotely.

FIGURE – M1



Switch
40-1007
$9.95 each

FIGURE – M2



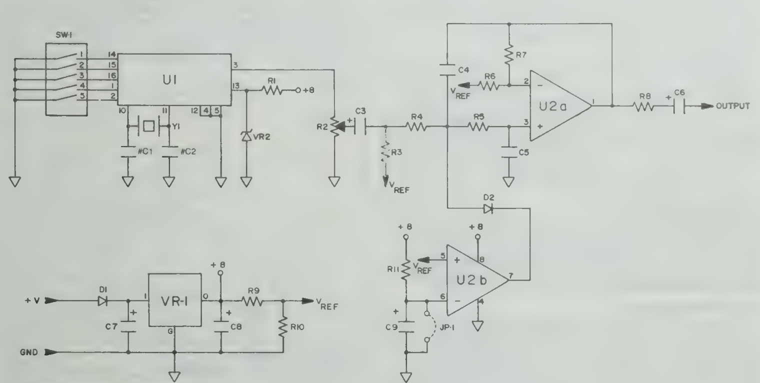
PLEASE NOTE:

The SS-32PA and SS-32PB have a unique feature in that any of the 32 internal positions may be programmed at the factory for ANY frequency desired. This means that if only six tones or less are required in a particular radio system, a single pole six position switch may be used with NO isolation diodes needed. The six position switch is simply connected to dip switch positions 1-5 (the sixth position is left open) with the switch common grounded. The six desired frequencies are programmed at the factory into positions 16, 24, 28, 30, 31, and 32. As the switch is rotated, the tones in each position will be generated.

RF INTERFERENCE

Although our encoders are not susceptible to RF, care must be taken when locating the unit, and how the wires are routed. In most cases of RF interference it has been found that the RF is coupled into the leads of the encoder and then fed back into the radio itself where the RF upsets the bias conditions in the transmitter. This causes distortion and other unusual effects. But under these conditions it will be noted that the encoder is still working properly. This is most common in portable hand held radios, since often the circuitry is compromised slightly to achieve the small size required. Often a small by-pass capacitor such as a 100pf. on the radio's circuit board works quite well. Also, keeping all leads as short as possible or re-routing the wires helps.

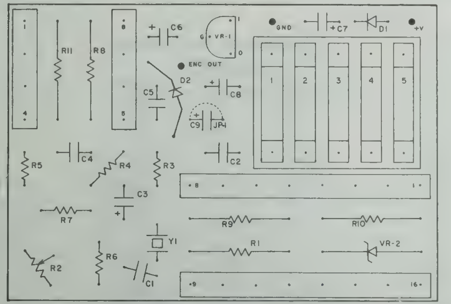
SS-32P INSTRUCTION SHEET



# THESE PARTS INSTALLED IN SS-32PB

MODEL SS-32P PROGRAMMABLE CTCSS TONE ENCODER

FIGURE 2



The price of the SS-32P is $28.95 each. Your PREPAID order will be sent POSTPAID by AIRMAIL or UPS Blue Label the same day it is received. California residents add 6% sales tax or supply resale card with order.

PARTS LIST SS-32P AND SS-32PB   * = PARTS OR VALUES IN SS-32PB

REF. DESIG.	CSI NO.	DESCRIPTION	PRICE
R1	06-4318	430 1/8 W 5% Carbon Film Resistor	22 ea
R8	06-1028	1k 1/8 W 5% Carbon Film Resistor	22 ea
R9, 10	06-1038	10k 1/8 W 5% Carbon Film Resistor	22 ea
R4, 5	06-3938	39k 1/8 W 5% Carbon Film Resistor	22 ea
R4a, 5a	*06-1158	110k 1/8 W 5% Carbon Film Resistor	22 ea
R3	06-1058	100k 1/8 W 5% Carbon Film Resistor	22 ea
R6, 7	06-1548	150k 1/8 W 5% Carbon Film Resistor	22 ea
R11	*06-6848	680k 1/8 W 5% Carbon Film Resistor	22 ea
R2	18-5020	5k Mepco Potentiometer	1 39 ea
C2	21-1800	18pF 5% Mono Ceramic capacitor	21 ea
C1	21-4710	470 pF 10% Mono Ceramic capacitor	29 ea
C4a, 5a	*21-4710	470 pF 10% Mono Ceramic capacitor	29 ea
C4, 5	21-1030	.01 µF Mono ceramic capacitor	14 ea
C3a	*21-1040	.1 µF 10% Mono Ceramic capacitor	34 ea
C3, 7, 8	19-1050	1 µF 10% tantalum electrolytic cap	21 ea
C9	*19-1050	1 µF 10% tantalum electrolytic cap	21 ea
C6	23-1000	10 µF 20% aluminum electrolytic cap	30 ea
Y1	48-3276	32.768 kHz crystal	60 ea
Y1a	*48-1000	1 MHz crystal	7 50 ea
D1, 2	48-4148	1N4148 75 PRV 100 mA Silicon diode	15 ea
VR2	48-5231	1N5231B 5 1 V 400 mW Zener diode	20 ea
VR1	48-3636	78L08 8V 100 mA Voltage Regulator	1 00 ea
U2	51-0062	TL062 BIFET dual op-amp	2 20 ea
U1	51-0110	IC 110 Programmable Encoder/Decoder	18 00 ea
SW1	40-1005	5 pole DIP switch	2 45 ea
2 ea.	09-4504	4 pin SIP socket	35 ea
2 ea.	09-4508	8 pin SIP socket	18 ea
3 ea.	05-1007	Bead chassis pin R50-1	01 ea
1 ea.	84-1041	P.C.B. SS-32P	5 00 ea
2 ea.	75-1002	Double sided tape square	05 ea
1 ea.	30-7035	Jumper wire	03 ea
1 ea.	SSP-1KW KIT	Wire kit	50 ea

COMMUNICATIONS SPECIALISTS, INC.
426 West Taft Avenue • Orange, CA 92665-4296
Local (714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. 1-800-854-0547

DESCRIPTION:

The Communications Specialists model SS-32P is a new concept in programmable CTCSS tone encoders. Any 32 tones between 67 Hz and 250 Hz (± .01 Hz) can be factory programmed into the SS-32P. Once the unit is programmed, the tones contained in memory are user selected by means of a 5 pole DIP switch. The tone output is a low distortion sine wave, with a variable amplitude of 0 to 5 volts p-p. The output impedance is nominally 1k ohm

FREQUENCY SELECTION:

The following instructions refer to Figure 1: Position the SS-32P so that the numbers on the DIP switch are readable, with number 1 in the left-hand corner. Notice the word "open" at the bottom center of the switch. When any switch is pushed down in the direction of the word open, a logical "1" is read at that switch. If a switch is depressed in a direction toward the numbers, a logical zero is generated. The setting of switches 1 to 5 are given in the tone location table Figure 1. Tones in the SS-32P can be selected by completing the following steps: 1) Locate the frequency to be encoded in the "Frequency" column, Figure 1. For custom tones use the custom tone location table supplied. 2) Find the digital code in the "Switch Setting" column that corresponds to the selected frequency. 3) Set switches 1 to 5 to match the digital code

POWER REQUIREMENTS:

The SS-32P will operate from a D.C. power supply of between 11 and 25 volts at 12 mA. Operation on voltages lower than 11 volts can be accomplished by jumpering the series protection diode D1, and voltage regulator VR1 out of the circuit. An appropriate series resistor can be installed in the A + line to allow the SS-32P to work on voltages greater than 25 volts. **Caution, use the plug-on wires, supplied, for all connections. Avoid soldering directly to the P.C.B. If possible, use keyed voltage supplied only when the transmitter is on.**

APPLICATION PRACTICES:

The microphone preamplifier stages in most radio transceivers have poor low frequency response. CTCSS tone encoders work best, therefore, if they are coupled to a point in the audio chain which is after the microphone preamplifier stage. Choose an injection point as close to the modulator as possible. The fewer stages between the encoder and modulator, the less distortion and limiting will degrade the transmitted tone. The SS-32P has a low output impedance and care should be taken to avoid loading high Z circuits. Use series isolation resistors in the range of 22k to 100k ohms when driving vacuum tube grid circuits. Whenever electronic devices are operated in R.F. environments, conducted and radiated interference are always possible. Hence, proper grounding and decoupling techniques should be used when installing tone encoders in radio transmitters. Keep wires short and away from R.F. power circuits. When necessary, use low value (100 pF to .001 μF) bypass capacitors at A + and audio output terminals.

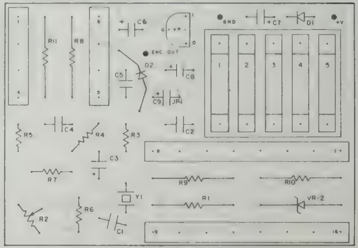
MOUNTING:

Please use the supplied double-sided foam tape squares to mount the SS-32P. Avoid the use of silicone rubber or glue.

BURST TONE:

The SS-32PB is the Tone Burst version of the SS-32P. The SS-32PB can be factory programmed with any 32 tones between 250 Hz and 3kHz (± .2 Hz). R11 can be varied for different burst times. The burst duration is set to a nominal 400 ms, with R11 = 680k. The burst time will increase 10% with each standard 5% value increase of R11. Conversely, the burst time will decrease 10% with each corresponding standard 5% value decrease of R11. For example, if R11 were changed from 680k to 750k, the burst time would go from 400 ms to 440 ms. Decreasing R11 from 680k to 620k would change the burst time from 400 ms to 360 ms.

FIGURE 2



CONTINUOUS TONE:

The SS-32PB can be configured to output continuous tone by either installing JP-1 or removing D2.

CONNECTING THE SS-32PB:

See Figure 2. Since the SS-32PB is designed to generate a "BURST" whenever power is first applied, it is necessary to connect the A + to a voltage that is switched on in transmit and off in receive. Because Burst tones are audible tones, the microphone preamplifier stages in radios are a suitable place to inject the SS-32P audio output. If the microphone input is selected as the injection point, a series isolation resistor may be required to keep the microphone from being loaded by the encoder. For low impedance circuits, choose a resistor between 1k and 10k ohms. Use 22k to 100k ohms for high impedance microphone inputs.

FIGURE 1

GROUP A TONE LOCATION TABLE

	SWITCH SETTING		
LOCATION	SWITCH NUMBER 1 2 3 4 5	FREQUENCY	CODE
1	0 0 0 0 0	67.0	XZ
2	1 0 0 0 0	71.9	XA
3	0 1 0 0 0	74.4	WA
4	1 1 0 0 0	77.0	XB
5	0 0 1 0 0	79.7	SP
6	1 0 1 0 0	82.5	YZ
7	0 1 1 0 0	85.4	YA
8	1 1 1 0 0	88.5	YB
9	0 0 0 1 0	91.5	ZZ
10	1 0 0 1 0	94.8	ZA
11	0 1 0 1 0	97.4	ZB
12	1 1 0 1 0	100.0	1Z
13	0 0 1 1 0	103.5	1A
14	1 0 1 1 0	107.2	1B
15	0 1 1 1 0	110.9	2Z
16	1 1 1 1 0	114.8	2A
17	0 0 0 0 1	118.8	2B
18	1 0 0 0 1	123.0	3Z
19	0 1 0 0 1	127.3	3A
20	1 1 0 0 1	131.8	3B
21	0 0 1 0 1	136.5	4Z
22	1 0 1 0 1	141.3	4A
23	0 1 1 0 1	146.2	4B
24	1 1 1 0 1	151.4	5Z
25	0 0 0 1 1	156.7	5A
26	1 0 0 1 1	162.2	5B
27	0 1 0 1 1	167.9	6Z
28	1 1 0 1 1	173.8	6A
29	0 0 1 1 1	179.9	6B
30	1 0 1 1 1	186.2	7Z
31	0 1 1 1 1	192.8	7A
32	1 1 1 1 1	203.5	M1

0 = ON = CLOSED = GND
1 = OFF = OPEN

GROUP B TONE LOCATION TABLE

	SWITCH SETTING	
LOCATION	SWITCH NUMBER 1 2 3 4 5	FREQUENCY
1	0 0 0 0 0	600.0
2	1 0 0 0 0	1000.0
3	0 1 0 0 0	1500.0
4	1 1 0 0 0	1600.0
5	0 0 1 0 0	1650.0
6	1 0 1 0 0	1700.0
7	0 1 1 0 0	1750.0
8	1 1 1 0 0	697.0
9	0 0 0 1 0	1800.0
10	1 0 0 1 0	1850.0
11	0 1 0 1 0	1900.0
12	1 1 0 1 0	770.0
13	0 0 1 1 0	1950.0
14	1 0 1 1 0	852.0
15	0 1 1 1 0	941.0
16	1 1 1 1 0	2000.0
17	0 0 0 0 1	2100.0
18	1 0 0 0 1	2150.0
19	0 1 0 0 1	2200.0
20	1 1 0 0 1	2250.0
21	0 0 1 0 1	2300.0
22	1 0 1 0 1	2350.0
23	0 1 1 0 1	2400.0
24	1 1 1 0 1	1209.0
25	0 0 0 1 1	2450.0
26	1 0 0 1 1	2500.0
27	0 1 0 1 1	2550.0
28	1 1 0 1 1	1336.0
29	0 0 1 1 1	2175.0
30	1 0 1 1 1	1477.0
31	0 1 1 1 1	1633.0
32	1 1 1 1 1	2805.0

0 = ON = CLOSED = GND
1 = OFF = OPEN

GENERAL INFORMATION ON CTCSS ENCODER HOOK-UP

POWER AND GROUND CONNECTIONS

The ground connection is typically very straight forward. The main ground foil on the printed circuit foil works well, or a connection to the chassis. Be careful of a radio which has multiple grounds, such as a chassis ground and a true vehicle ground. A GE Mastr Pro is a good example.

The power connection can be any unregulated positive D.C. voltage from +6.0 to +25V. Use a regulated voltage if it is convenient. However, with voltages below 9.0VDC, remove VR-1, jumpering "1" to "0" on the PCB. Also jumper out diode D1. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 25VDC. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

Mobiles, 12V negative ground — standard hook-up (see above).
Mobiles, 12V positive ground — reverse board + V and GND connections.
Mobiles, 6V pos. or neg. ground — use B + dropping method.
Bases — use appropriate figure 1, 2, 3.
Portables, 9V or less — by-pass regulator, VR-1.

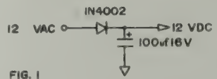


FIG. 1

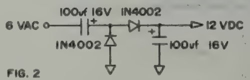


FIG. 2

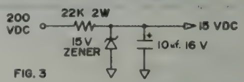


FIG. 3

PROCEDURE FOR CONNECTING SUB-AUDIBLE ENCODER TONE TO TRANSMITTER

The encoder tone output is typically connected just prior to the modular stage. Typical connections would be to the center of the deviation control, to the input of the final audio driver, to the varactor modulator diodes or to the manufacturer's normal connection point. This connection point varies with each different model radio, and you must determine which provides the best results. In a tube type transmitter, the grid of the modulator is often used, or a varactor kit should be used to modulate the crystal directly in a tube type or solid state transmitter, see figure E1. The VARACTOR (transistor base to collector junction of an NPN silicon transistor) changes A.C. voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method. Various values of coupling capacitors are shown for different frequency ranges of the transmitter. A higher value of capacitance will increase the deviation level, however if the capacitance is too high, it may be difficult to set the transmitter on frequency. Varactor Kits are available from us for $3.00 each. Use this method if other connection points prove unsuccessful.

DO NOT connect the encoder tone to the microphone input as this invariably causes excessive tone and harmonic distortion due to the frequency response of the transmitter's speech amplifier. The speech amplifier has a typical response of 300Hz to 3000Hz and does not permit the fundamental tone to be transmitted. This is the usual cause of a distorted tone output as monitored on a deviation scope.

The output of our encoder is low Z, so it is capable of driving low Z loads. If you are driving a high Z load such as 100K deviation pot, then a series isolation resistor should be used so the encoder will not load down the normal voice modulation. This resistor value must be determined experimentally, but a 100K resistor would be a good starting point. This value could change from 10K to 1 meg depending on the radio used. If the tone output of the encoder is connected to a point in the transmitter where DC Bias is present, a .33uf to 1uf capacitor may have to be added in series with the encoder to keep this Bias from being upset.

If tone distortion continues to be a problem, then a capacitor can be placed on the tone output to provide additional filtering where required, see figure E2. This is most noticeable in phase modulators since the frequency response seems to be quite poor at the low end of the audio range. If you are using a deviation scope, then little spikes will be riding on the sine wave output, and this will sound like a buzz. The additional filtering will cure the problem. True FM modulators do not have this problem and are very easy to work with and interface very well with sub-audible encoders. These modulators can be identified quite easily since the audio is fed into a varactor which is often connected in parallel with the crystal. If the purity of the encoder output is in question, look at the output of the encoder with an oscilloscope.

Most UHF transmitters interface quite well with sub-audible encoders. This is primarily due to the high multiplication factor from the modulator to the final amplifier stage. Because of the lower number of multiplication stages in low band transmitters, sufficient deviation level can sometimes be difficult to obtain.

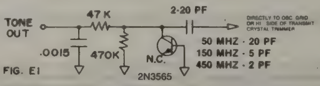


FIG. E1

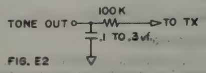
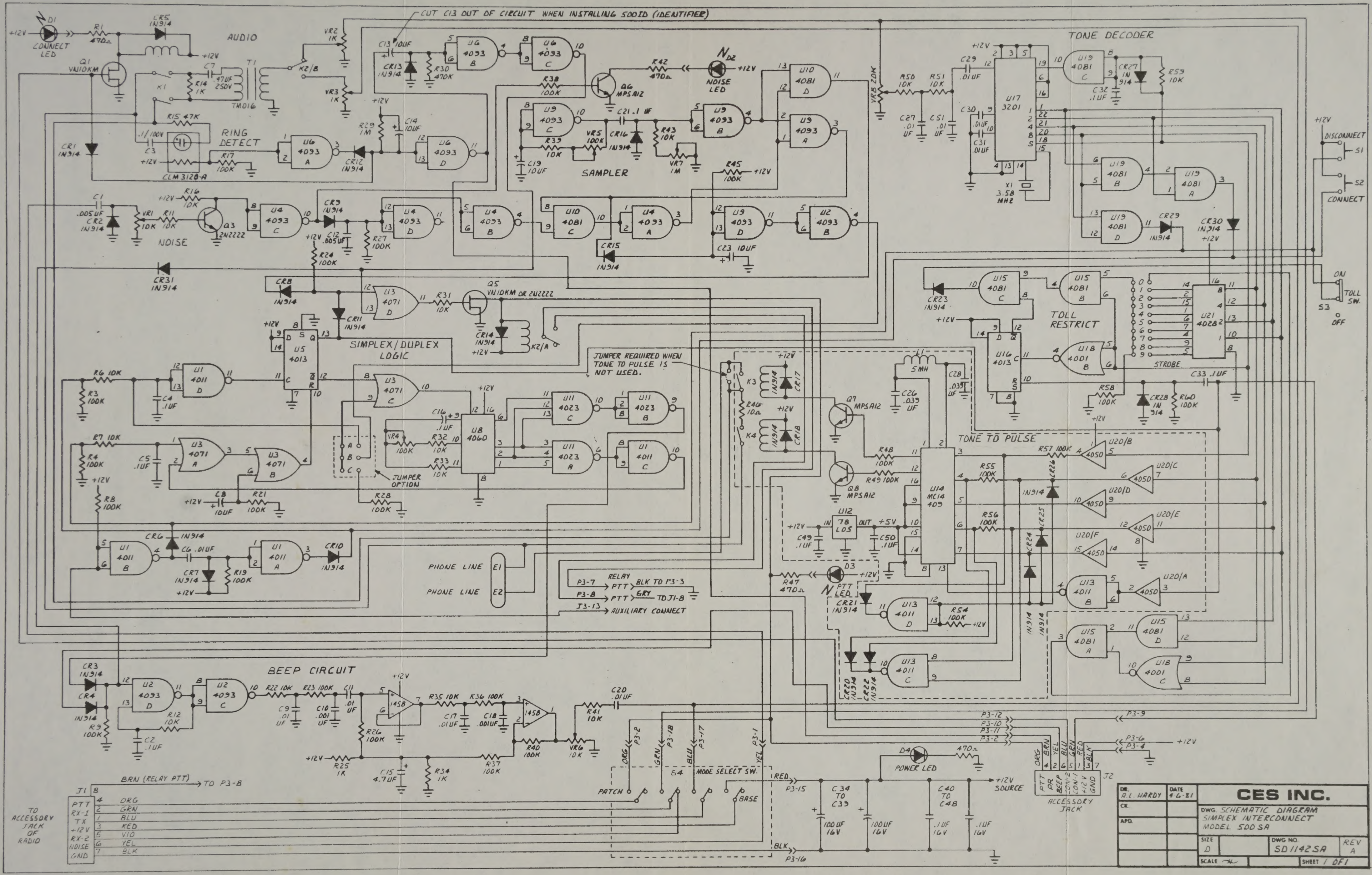


FIG. E2



DR. A.L. HARDY
DATE 4-6-81
CK.
APD.

CES INC.

DWG. SCHEMATIC DIAGRAM
SIMPLEX INTERCONNECT
MODEL 500SA

SIZE D
DWG NO. SD1142SA
REV A
SCALE ~~
SHEET 1 OF 1

GENERAL INFORMATION ON CTCSS ENCODER HOOK-UP

BURST TONE: